Spicer® Drive Axle

Service Manual

Spicer® Drive Axle

AXSM-0400

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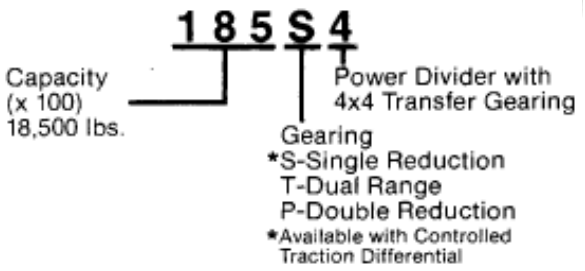
Spicer Axle Service and Maintenance Instructions
The Spicer 4x4 Drive System

Dana Corporation presents this publication to aid in maintenance and overhaul of Spicer 4x4 Drive systems. Axle models and other equipment covered in this publication are listed below.

Spicer Rear Drive Axles for 4x4 Drive Systems

Model No. Identification
4x4 Rear Axle



Axle Capacity	Axle Gearing Types
18,500 lbs.	185S4 Single Reduction* 185T4 Dual Range 185P4 Double Reduction
22,000 lbs.	220S4 Single Reduction* 220T4 Dual Range 220P4 Double Reduction
23,000 lbs.	230S4 Single Reduction* 230T4 Dual Range 230P4 Double Reduction
26,000 lbs.	260S4 Single Reduction* 260T4 Dual Range 260P4 Double Reduction
30,000 lbs.	300S4 Single Reduction* 300T4 Dual Range 300P4 Double Reduction
35,000 lbs.	350S4 Single Reduction* 350T4 Dual Range 350P4 Double Reduction

*Available with Controlled Traction Differential

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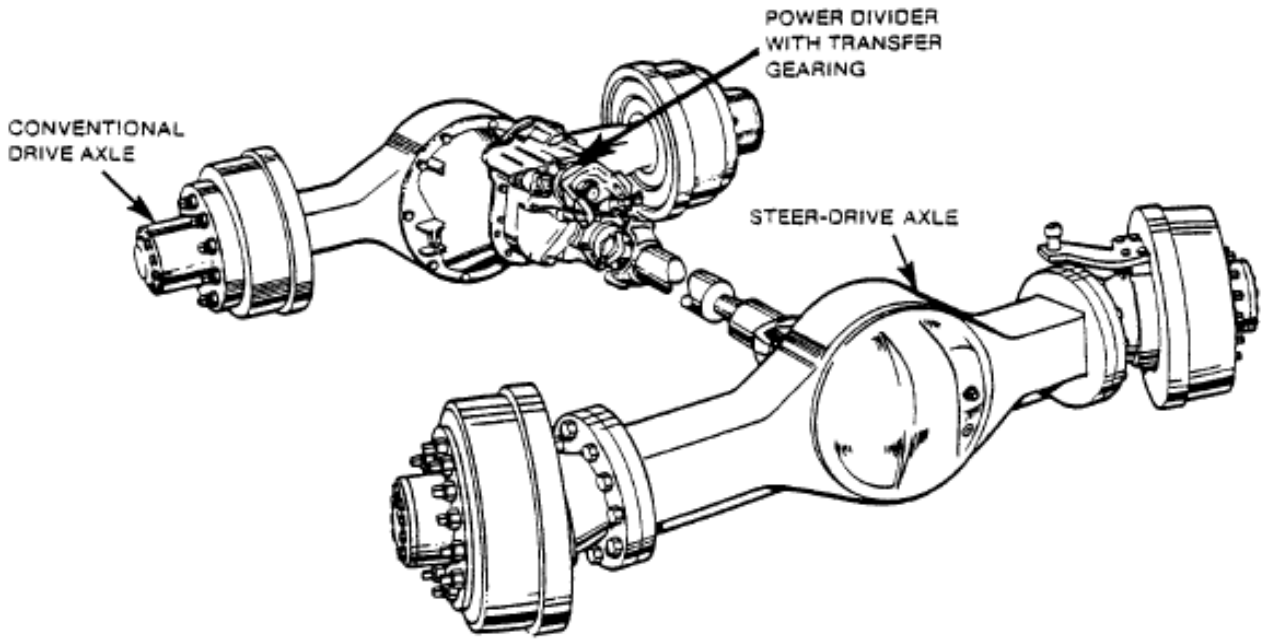
Spicer 4x4 Drive System

Spicer combines a unique power divider with a Spicer conventional axle to provide a 4x4 rear drive axle. This drive axle coupled by a driveline to a steer-drive axle are the basic components of the Spicer 4x4 Drive System.



Gearing Combinations

The Spicer 4x4 Drive System is available in the following gearing combinations:

Operating Mode	Front Steer-Drive Axle	Rear Drive Axle
4x4 and 4x2	Single Reduction	Single Reduction
4x4	Single Reduction with Controlled Traction Differential	Single Reduction with Controlled Traction Differential
4x4 and 4x2	Double Reduction	Double Reduction
4x4 and 4x2	Dual Range	Dual Range
4x4 (Low Range) 4x2 (Low or High Range)	Single Reduction (low range of Dual Range) (Example 7.17)*	Dual Range (5.29/7.21)*

*Ratios must match within 3% difference.

Shift Systems

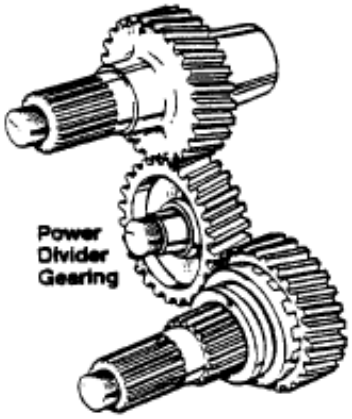
The vehicle drive uses cab-mounted air control valves to control the drive system operating modes, axle range selections and controlled traction differential operation. Detailed descriptions of air shift systems which control these functions are contained in the Shift System Section of this manual.

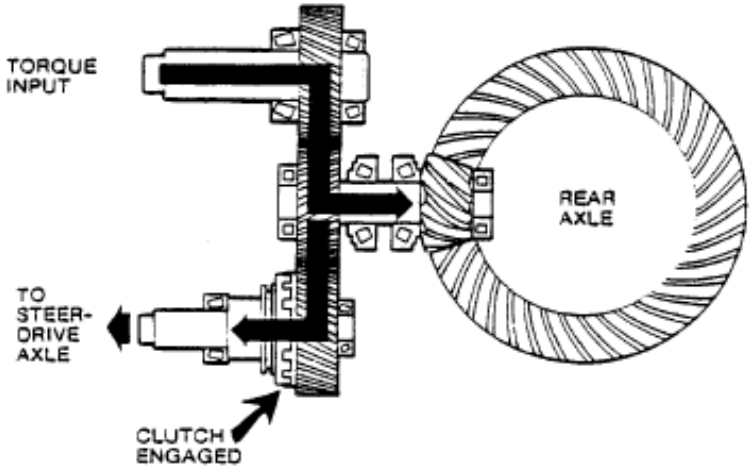
Operation

The power divider transfer gearing provides the means to deliver power to the steer-drive axle. Operating modes and power flow are illustrated below. The transfer gearing includes a mechanical sliding clutch which, in turn, controls engagement and disengagement of the driveline to the steer-drive axle.

4x4 Operating Mode

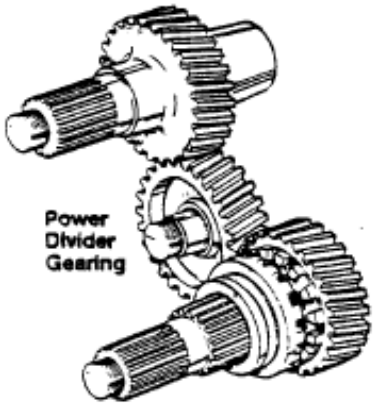
In 4x4 mode, the sliding clutch is engaged and drive is direct from transmission to the helical gear train in the power divider. At this point, power is distributed through the three helical gears to the rear axle and to the steer-drive axle.

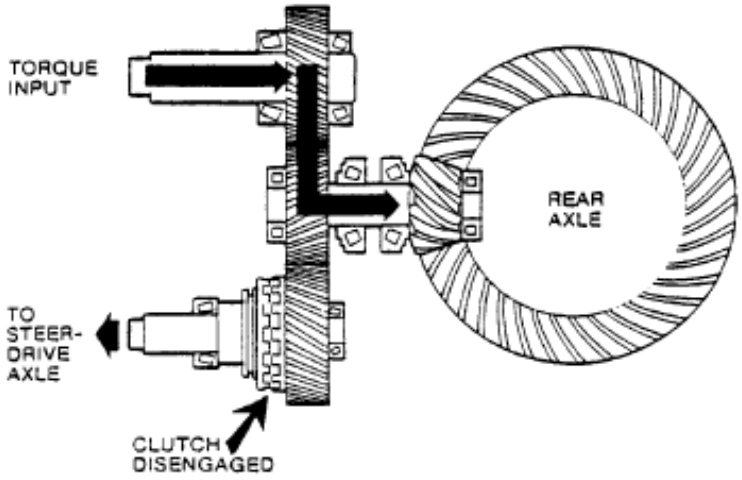




4x2 Operating Mode

For 4x2 operating mode, the sliding clutch is disengaged and power flow is direct from transmission, through two helical gears with 100% to rear axle.





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ESD-18 Steer-Drive Axle

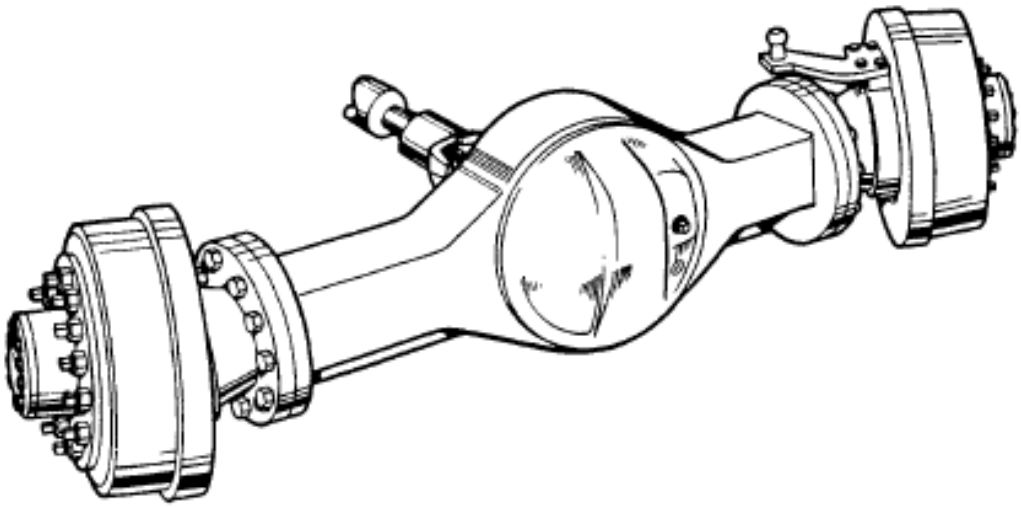
Introduction

This manual includes instructions for the Spicer ESD-18 Steer-Drive Axle (capacity rating 18,000 lbs.). This axle may include one of three types of gearing: single reduction, dual range or double reduction. The single reduction gearing may be equipped with a Spicer Controlled Traction Differential. For service information on this special differential, refer to separate section in this manual.

The axle housing is one piece. A special ball and socket assembly and wheel end equipment are provided at each end of the housing.

The axle shaft assembly on each side of the axle is equipped with cardan-type universal joint. These joints are housed in a trunnion-type ball and socket assembly to provide steering capabilities.

The axle is equipped with Spicer Single-Anchor Pin Air Brakes (16-1/2” x 5”).



Wheel Alignment Specifications

Camber	1/2°
Caster	3°
Toe-in	0 + 1/8"

General Inspection

Proper wheel alignment promotes longer tire wear, ease of handling, and minimizes strain on front suspension and axle components.

Do not check and adjust front wheel alignment without first making the following inspection for front end maladjustments, damage or wear.

1. Check the air pressure in all the tires. Make sure that the pressures agree with those specified for the tires and vehicle model being checked
2. Raise the front of the vehicle off the floor. Grasp each front tire at the front and rear, and push the wheel inward and outward. If any free play is noticed between the brake drum and the brake backing plate, adjust the wheel bearings. Replace the bearings if they are worn or damaged. Adjust and/or replace worn or damaged bearings.
3. Check brakes for dragging and wheels for proper balance.
4. Check all steering linkage for wear or maladjustment. Adjust and/or replace worn parts.
5. Check the steering gear mounting bolts, and torque them wherever required. Check the front spring clips (U-bolts) and the spring tie bolt, and tighten them if necessary.
6. Spin each front wheel with a wheel spinner, and check and balance each wheel as required.
7. Rotate each front wheel slowly, and observe the amount of lateral or side runout. If the wheel run out exceeds 1/8 inch, replace the wheel or install the wheel on the rear.

Kingpin

Check kingpin bearing nut tightness after first 1000 miles; yearly after that.

Front Wheel Bearings

1. When the front wheel bearings are excessively worn or damaged, check the bearing cups for proper installation before removing them for replacement. If a cup is improperly seated in the hub, inspect the hub for burrs, rough spots, or other irregular surfaces that would prevent seating the cup properly.
2. Bearing damage is often caused by lack of lubrication or improper adjustment. When installing bearing cups or cones and rollers, make sure that the specified lubricant is properly used. Adjust the bearings after installation.

Wheels

1. Wheel stud nuts should be inspected and tightened twice in the first 500 miles, and again after 1,000 miles to avoid accidental loosening of the wheels. Loose wheel stud nuts may cause shimmy and vibration. Elongated stud holes in the wheels may also result from loose stud nuts.
2. Keep the wheels and hubs clean. Stones or lumps of mud wedged between the wheel and drum will unbalance a wheel and tire.
3. Check for damage that would affect the runout of the wheels. Wobble or shimmy caused by a damaged wheel will eventually damage the wheel bearings. Inspect the wheel rims for dents that could permit air to leak from the tires.

Tires

1. The tires should be checked frequently to be sure that the air pressures agree with those specified for the tires and vehicle model.
2. Inspect the tire treads, and remove all stones, nails, glass, or other objects that may be wedged in the tread. Check for holes or cuts that may permit air leakage from the tire, and make the necessary repairs.
3. Inspect the tire side walls for cuts, bruises, and other damage. If internal damage is suspected, demount the tire from the wheel for further inspec tion and repair or replacement.
4. Check the tire valve for air leaks, and replace the valve if necessary. Replace any missing valve caps.

Tie Rod and Tie Rod Ends

Tie rods are of three-piece construction, consisting of a tie rod and two rod end assemblies. The ends are threaded to the rod and locked with clamp bolts. Right and left hand threads are provided for toe-in adjustment. Tension on ball stud in the rod ends is self-adjusting and requires no attention in service other than periodic inspection to see that the ball studs are tight in the steering knuckle arms.

Fittings are provided for periodic lubrication on some types of tie rod ends. Where no fittings are used, the tie rods have been lubricated at assembly and no further lubrication is necessary.

Wheel Alignment Factors

In checking wheel alignment, or when installing new axle parts, both wheels should be checked in the following order:

1. Camber.
2. Caster.
3. Toe-in.

There are many types of alignment checking equipment that accomplishes the same purpose, although the method of using the equipment may differ. Refer to equipment manufacturer's instructions for correct procedures. Regardless of make or type of equipment used, the checking and adjusting operations should be done in the sequence outlined above.

NOTE: When checking wheel alignment, make sure the truck is placed on a level floor.

Camber Angle

Camber is the amount in degrees that the wheel inclines away from the vertical at the top, as viewed from the front of the truck.

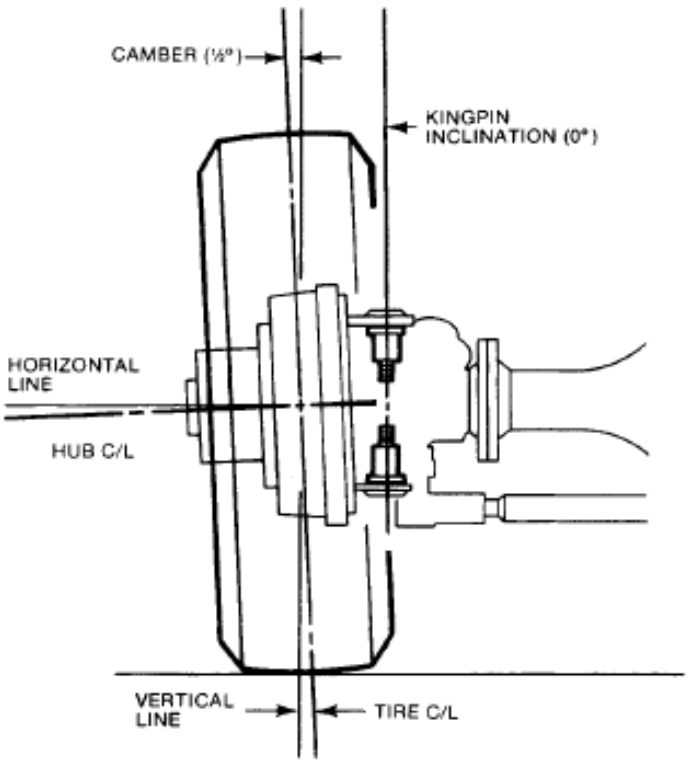
"Positive" camber is an outward tilt or inclination of the wheel at the top.

"Negative" or reverse camber is an inward tilt of the wheel at the top.

The amount of camber used depends on the amount in degrees the wheel end is inclined. An incorrect camber angle causes the side of the thread to wear, resulting in abnormal tire wear. Unequal camber in the front wheels will cause the truck to lead to the right or left. The truck will lead to the side which has the most positive camber. Normal camber angle is ½ degree.

Camber is nonadjustable and is only changed if the axle ball assembly or axle housing becomes bent.

Camber



Camber Angle Should Be ½°.
(Left-Hand Wheel)
(Viewing Rear of Axle)

Caster Angle

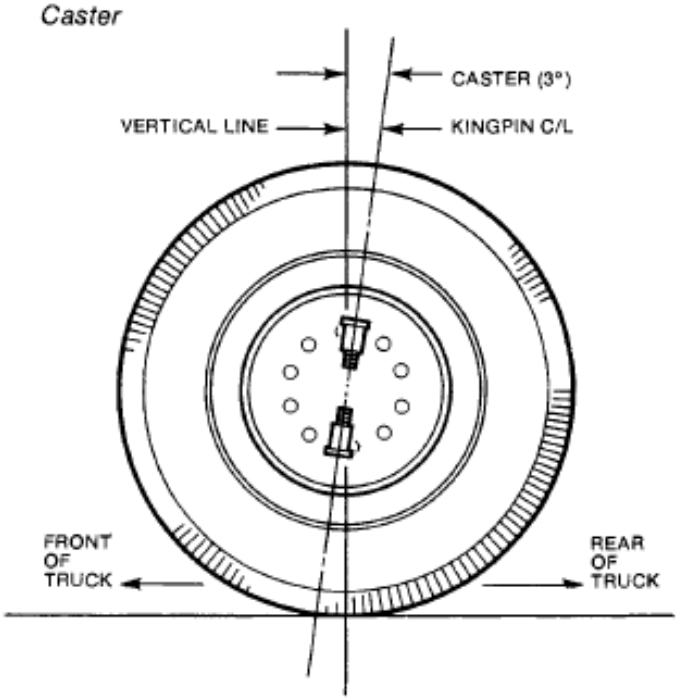
Caster is the amount in degrees the top of the kingpin is inclined toward the front or rear of the truck, as viewed from the side of the truck. The caster angle can range from a positive angle to a negative angle.

Positive caster is the tilting of the top of the kingpin toward the rear of the truck, while negative, or reverse caster, is the tilting of the top of the kingpin toward the front of the truck.

Positive caster imparts a trailing action to the front wheels, while a negative, or reverse caster causes a leading action. The correct amount of caster helps to keep the wheels in the straight-ahead position. When turning a curve, caster acts as a lever, assisting the driver to return the wheels to the straight-ahead position.

Caster specifications are established and adjusted in all new trucks. However, variations in spring equipment, type of service, tire or wheel size or even wheel base may make a slight change in caster angle desirable to provide the best possible steering stability. The caster angle must be equal at both wheels.

Caster



Caster Angle Should Be 3°.
(Viewing Outside of Left-Hand Wheel)

Adjust Toe-in

Toe-in should be set at "0" to ⅛". The front of the wheels should be the same distance apart (or ⅛" closer) than the rear of the wheels.

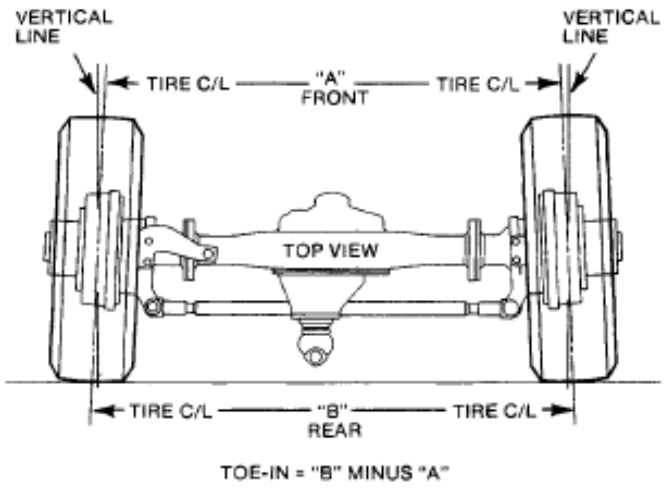
Change adjustment by turning tie rod to change its length.

Adjustment can be checked as follows:

Scribe a line at center of each tire tread completely around the tire (line must begin and end at the same point). This can be done by rotating wheel while holding chalk against tire tread.

Measure the line (on the axle centerline, see drawing) at front of the tires. Repeat measurement at rear of tires. Compare measurements. Front measurement (A) should be same (or ⅛" shorter) than rear measurement (B). Adjust tie rod as necessary to achieve these tolerances.

Toe-in



Toe-in Should Be 0" to ⅛"
(Viewing Top of Axle)

Wheel Bearings: Pack with wheel bearing grease NLGI No. 1 or No. 2. Lubricate during bearing adjustment or annually.

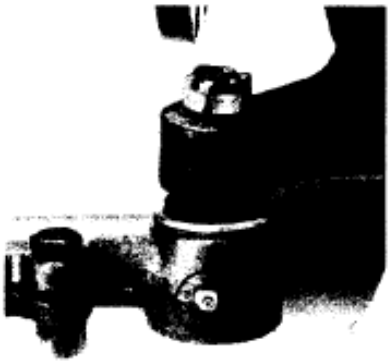
Axle Ball and Socket: Use chassis lube. Rotate axle ball socket to one extreme and coat inside area of socket with lube. Turn ball socket to opposite extreme and lubricate ball.

Differential Carrier: Refer to Lubrication, Section 3.

Brake Camshaft Bushings: Use chassis lube and lube fitting (located in brake chamber mounting bracket). Apply with lube gun until lube can be seen escaping from slack adjuster end of camshaft.

Upper Kingpin Bearings.

Lower Kingpin Bearings.



Tie Rod End Ball Stud.

Kingpin Bearings: Use wheel bearing grease NLGI No. 1 or No. 2. Lubricate through lube fitting in upper bearing cover. For lower bearings, remove pipe plug and install lube fitting. Lubricate with lube gun then reinstall plug. Frequency: Lubricate at Axle Lube Change.

Tie Rods: Use chassis lube and lube fitting (one in each tie rod end). Lubricate at axle lube change intervals.

Slack Adjuster: Lubricate with lube gun at fitting mounted on slack adjuster. Lubricate at Axle Lube Change.

Overhaul

The following instructions cover wheel end equipment for both sides of the axle. Instructions are the same for left-hand and right-hand wheel ends, except where specified otherwise. Left-hand and right-hand are determined by facing the differential carrier side of the axle.

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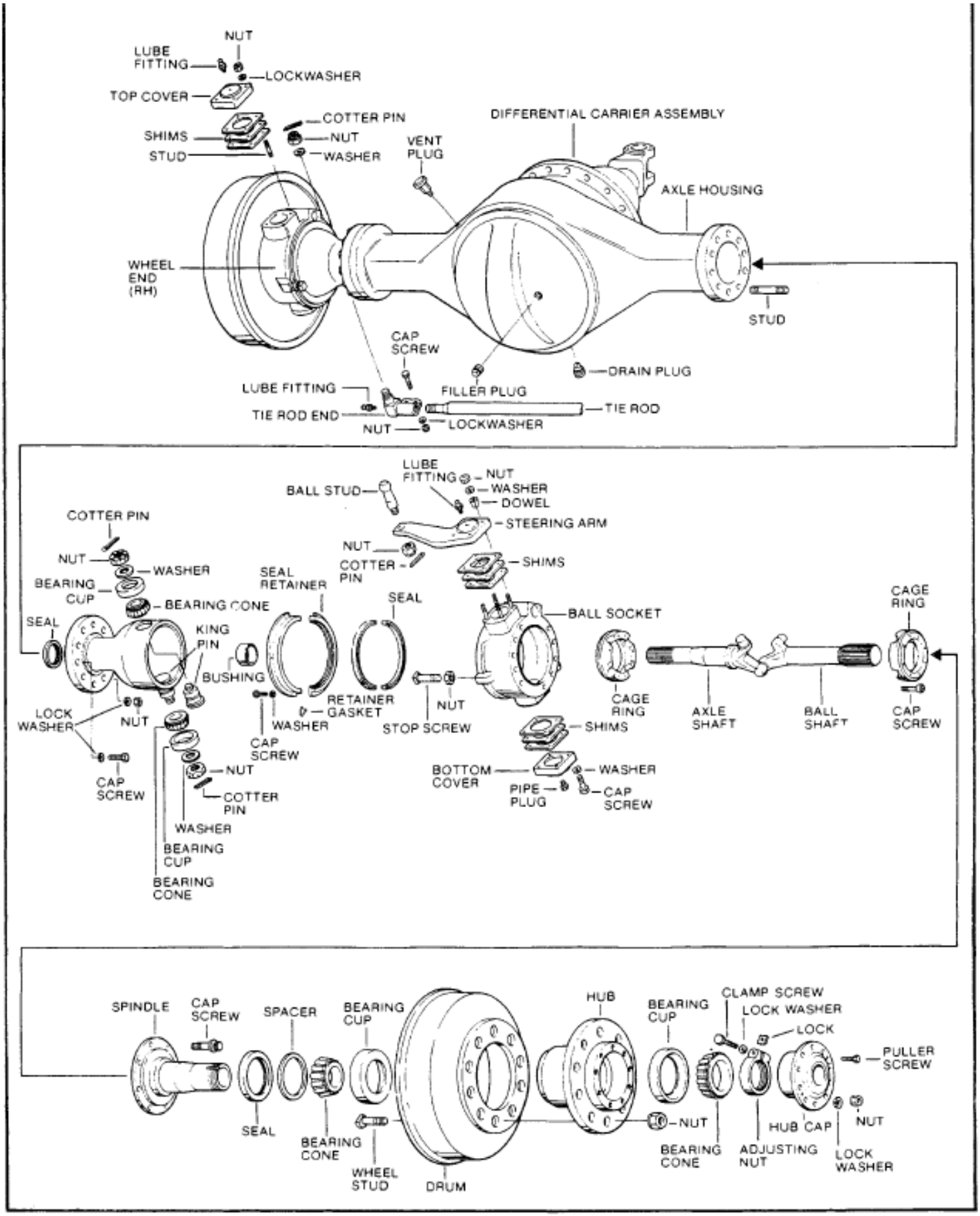
Steer-Drive Axle Steering and Wheel End Equipment



Disassembly

Remove Wheels and Tires, Drain Lubricant

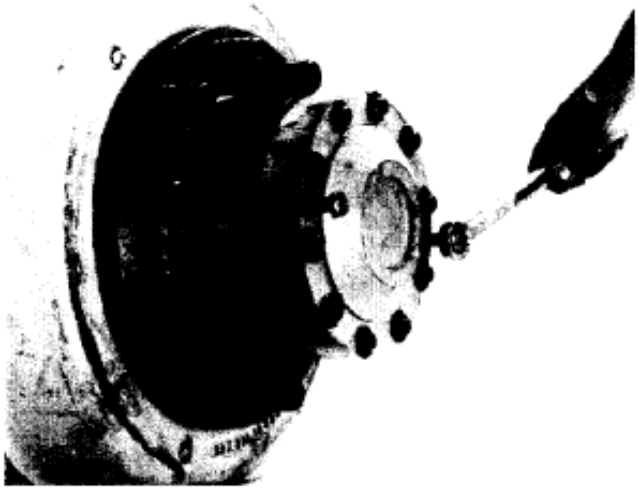
1. Jack up both sides of the axle until tires clear the ground.

WARNING: TO PREVENT DAMAGE OR PERSONAL INJURY, USE PROPER AXLE STANDS OR SUPPORTS SO THAT VEHICLE DOES NOT REST ONLY ON THE JACKS.

2. Remove wheels and tires.

3. Drain axle lubricant.

NOTE: Axle lube will drain from housing when axle shafts are removed.



Removing Hub Cap with Puller Screws.

Remove Wheel Hub and Brake Drum

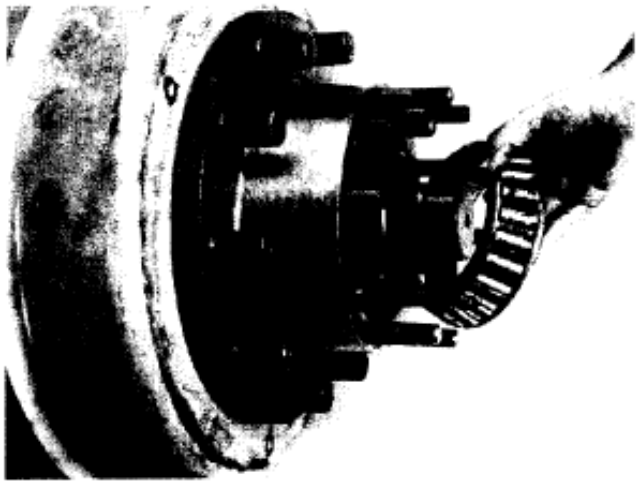
1. Back off slack adjuster brake adjustment to provide sufficient lining clearance so that brake drums can be easily removed.

2. Remove nuts, lockwashers and hub cap.

NOTE: Puller screw holes are provided if difficulty is experienced in removing hub cap (see photo).

3. Remove clamp screw and lockwasher from wheel bearing adjusting nut. This will release the nut lock. Remove lock then unscrew and remove bearing adjusting nut.

4. Remove wheel outer bearing cone (see photo).



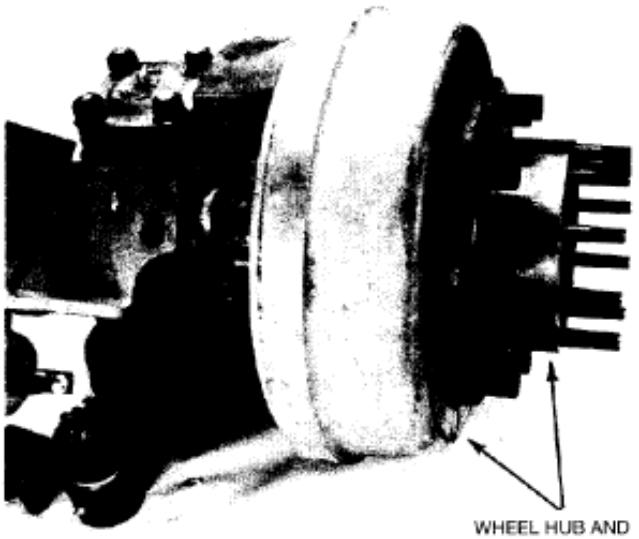
Removing Wheel Outer Bearing Cone.

NOTE: If bearing cone is not to be replaced, identify its location so it can be returned to its original position.

5. Remove wheel hub and drum assembly (see photo). To disassemble hub, remove oil seal and spacer then lift out inner bearing cone.

6. Inspect bearing cones and cups for pitting, wear or other faulty condition. If cup replacement is necessary, remove from hub using suitable puller. Replace bearings in sets (cup and cone).

7. Inspect brake drums for cracks, discoloration due to hard spots, heat checking, glazing, grooving or severe out-of-round condition. Replace cracked drums.



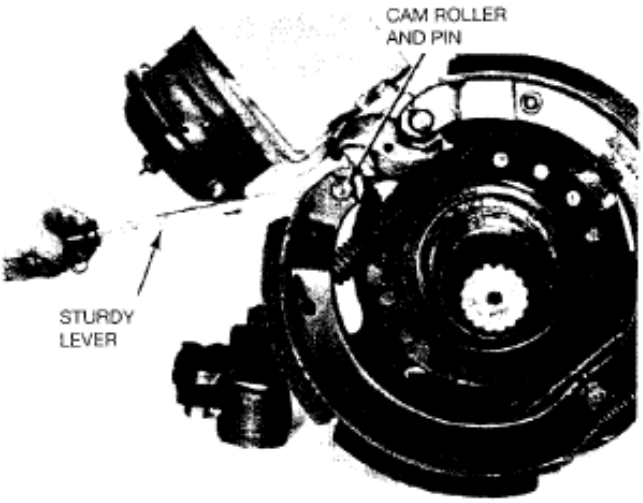
Removing Wheel Hub and Drum Assembly.

Disassembly (Cont'd)

Remove Brake Shoes and Inspect Lining

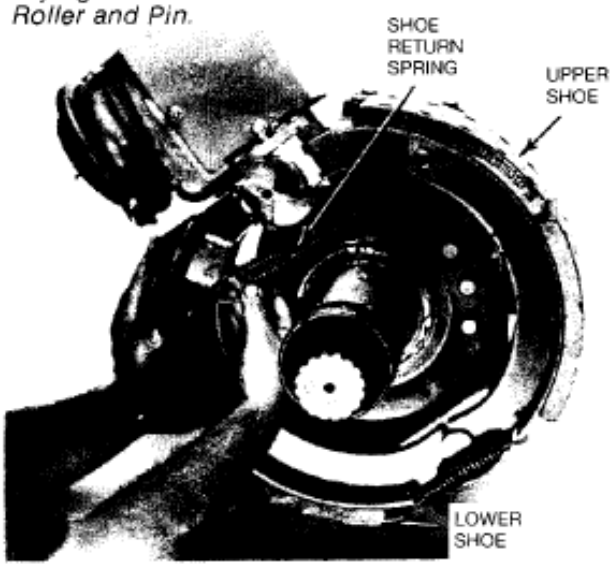
1. Pry down on lower (or rear) brake shoe (using a sturdy lever, see photo) until cam roller and pin can be removed. Repeat procedure for other shoe.

WARNING: TO AVOID POSSIBILITY OF PERSONAL INJURY, MAKE CERTAIN YOU HAVE A FIRM HOLD ON PRYING LEVER BEFORE REMOVING ROLLER AND PIN.



Prying Down on Brake Shoe to Remove Cam Roller and Pin.

2. Lift lower (or rear) shoe to relieve tension, then remove shoe return spring (see photo).



3. Lift upper (or forward) shoe off anchor pin, then remove both shoes and shoe retainer springs (see photo).

4. Inspect brake linings as follows and replace if any one of the following conditions exists:

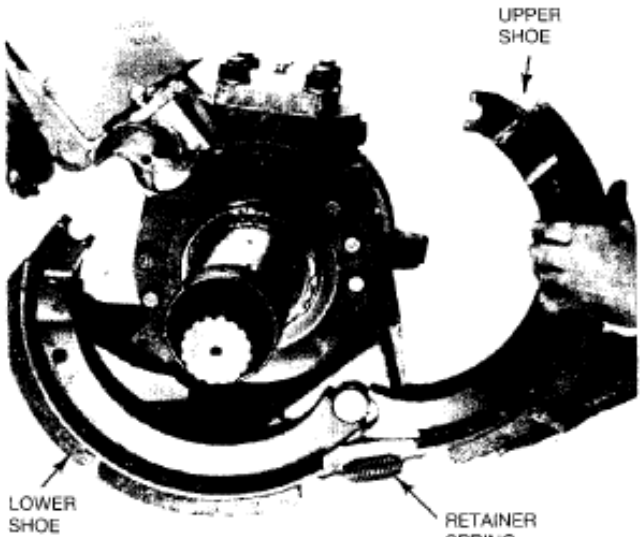
a. Lining thickness is 3/16" (4.5mm) or less at the thinnest point, or if lining is worn to 1/16" (1.5mm) or less to rivet heads.

b. Lining is cracked or improperly worn.

c. Lining is loose on shoe. Replace loose rivets or bolts.

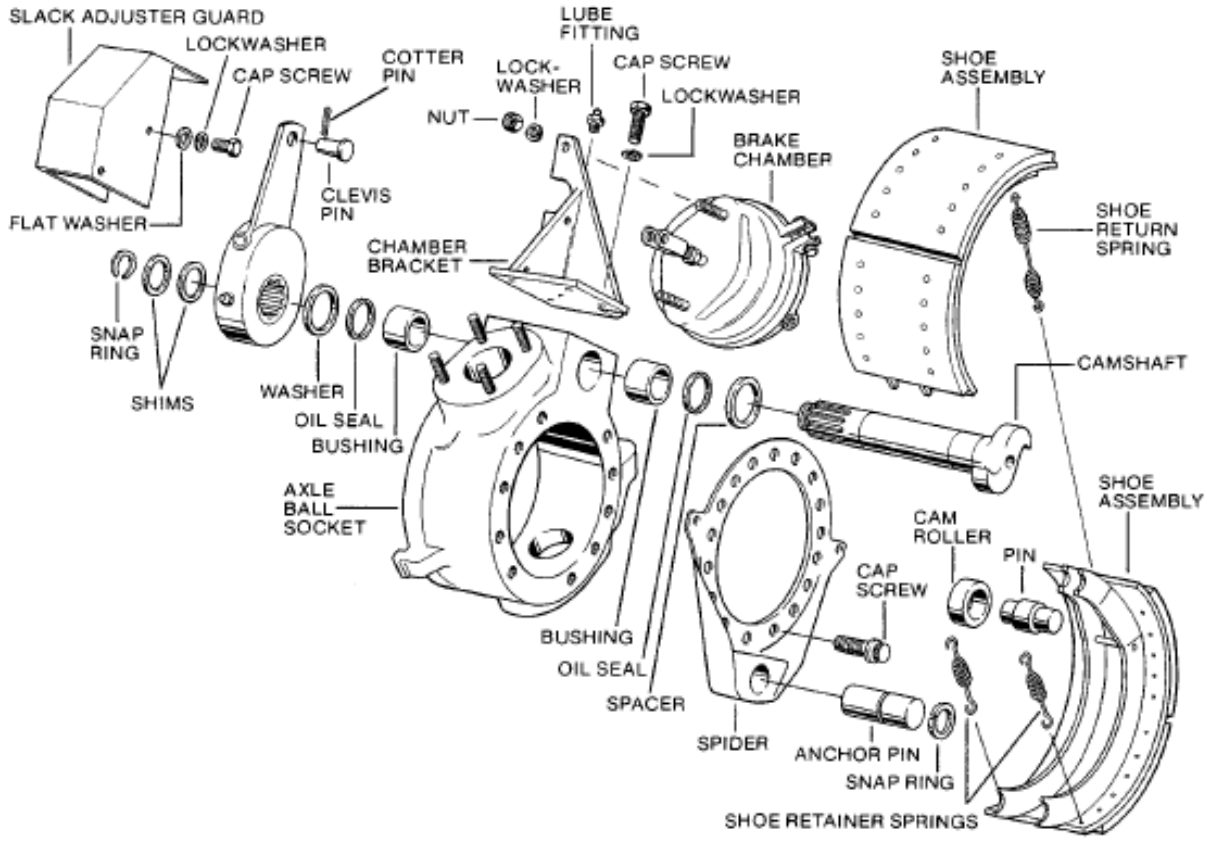
d. Lining is oil-soaked or contaminated with other foreign material.

NOTE: Replace brake springs with a brake reline.



Removing Brake Shoes.

Brakes (Left-hand Illustrated)

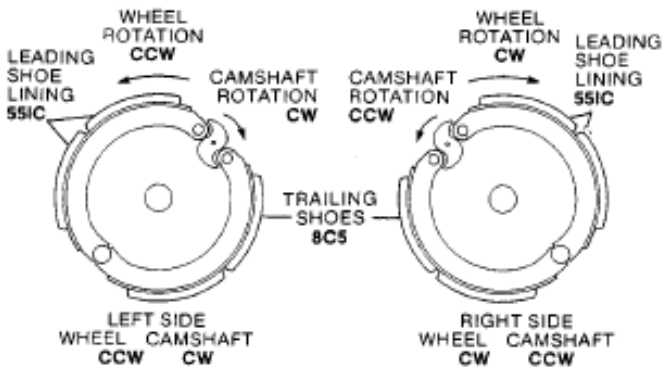


Brake Reline (Lining Selection)

When wheel and brake camshaft rotation is in the same direction, linings for the leading and trailing shoes are the same. When wheel and brake camshaft rotation is in opposite directions, linings will vary.

CAMSHAFT ROTATION OPPOSITE WHEEL ROTATION

(Brake chamber mounted toward front of axle)



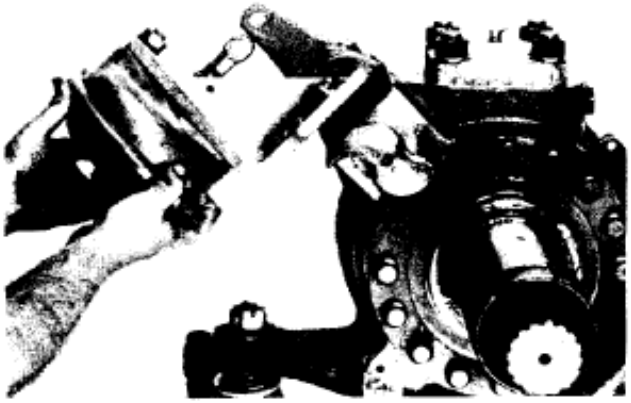
Disassembly (Cont'd)

Remove Brake Chamber

1. Remove cap screws, lockwashers, flat washers and guard covering slack adjuster.

2. Disconnect air line at brake chamber. Remove cotter pin and clevis pin at slack adjuster arm. To remove brake chamber and bracket assembly, remove cap screws and lockwashers fastening bracket to ball socket (see photo).

3. Inspect chamber for air leaks, cracked housing, bent push rod, loose clamp ring, clogged vent holes, or loose air fitting. Repair or replace as recommended by manufacturer.



Removing Brake Chamber and Bracket Assembly.

Remove Slack Adjuster

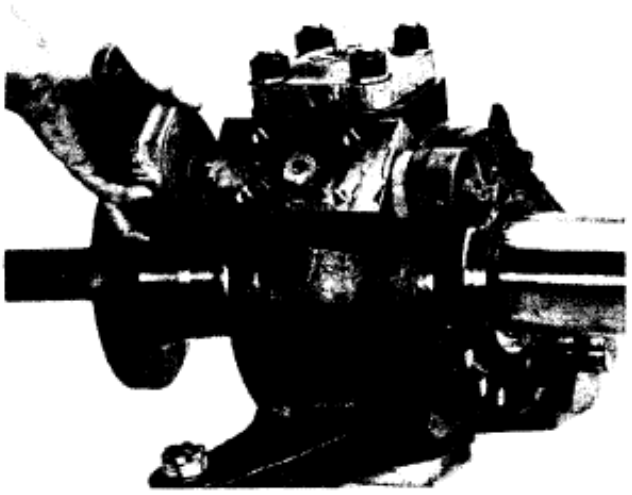
1. Remove snap ring and shims then slide slack adjuster off camshaft splines (see photo).

2. Check for spline wear. Measure backlash in slack adjuster. If backlash is more than 0.094" (measured 6" from camshaft centerline), replace slack adjuster.

Check for ability to rotate adjusting nut at least one complete revolution, in both directions. If excessive force is required (greater than 15 ft-lbs.), replace slack adjuster.

For additional inspection procedures, refer to manufacturer's instructions.

NOTE: Repair of slack adjuster is not recommended. Replace a faulty unit as an assembly.



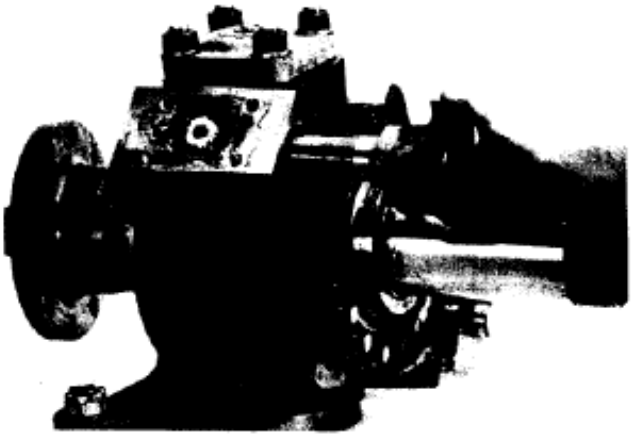
Removing Slack Adjuster.

Remove Camshaft

1. Before removing camshaft, check for free rotation. Also check camshaft side movement with dial indicator. If movement is greater than 0.020", camshaft journals or bushings are worn. When excessive wear is indicated, replace oil seals, bushings and/or camshaft.

2. With snap ring and slack adjuster removed as described previously, withdraw camshaft from ball socket (see photo). At this time, again inspect camshaft. Visually check journals for wear or corrosion. If wear or roughness is present and can be felt by hand, replace camshaft.

Also check camshaft spline for cracks or deformation. Check "S" cam for brinelling, cracking or flat spots. Replace if ridge can be felt between worn area and cam surface.



Removing Camshaft

Disassembly (Cont'd)

Remove Spindle and Brake Spider

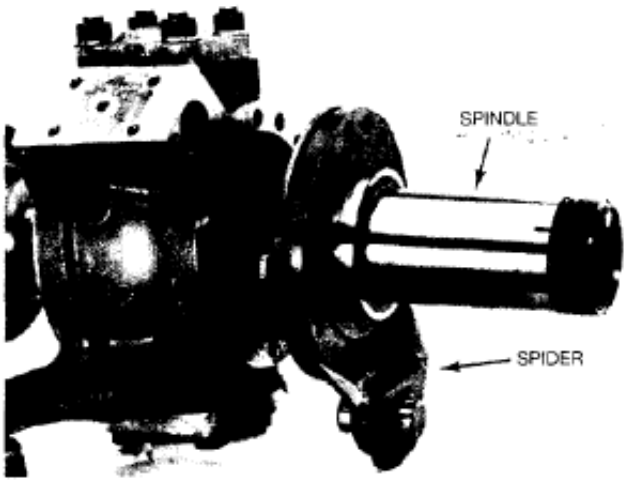
1. Remove cap screws fastening spindle and spider to ball socket.

2. Before removing spindle and spider, place container under ball socket to catch falling grease.

3. Remove spindle and spider (see photo). If spindle removal is difficult, loosen by tapping with a soft-nosed hammer.

IMPORTANT: Exercise care when tapping spindle. Striking too hard could crack the spindle metal wall.

4. Inspect anchor pin for secure mounting in brake spider. If pin is loose or if grooved more than 0.031", replace spider and pin as an assembly.



Removing Spindle and Brake Spider.

Remove, Inspect and Disassemble Axle Shaft Assembly

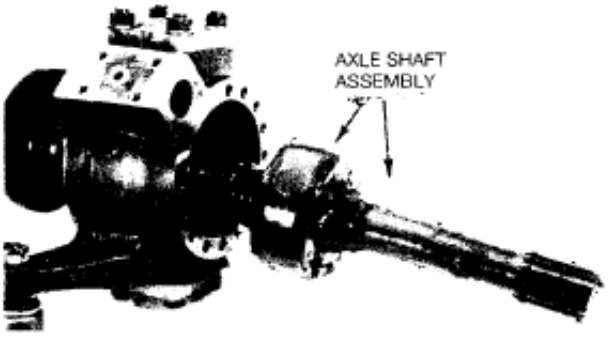
1. Turn ball socket to a perfect, straight-ahead position. Then remove axle shaft assembly (inner and outer shafts and universal joint) (see photo).

NOTE: With both (LH & RH) axle shafts removed, the differential assembly can be removed from axle housing (see Differential Carrier Section, page 2—11).

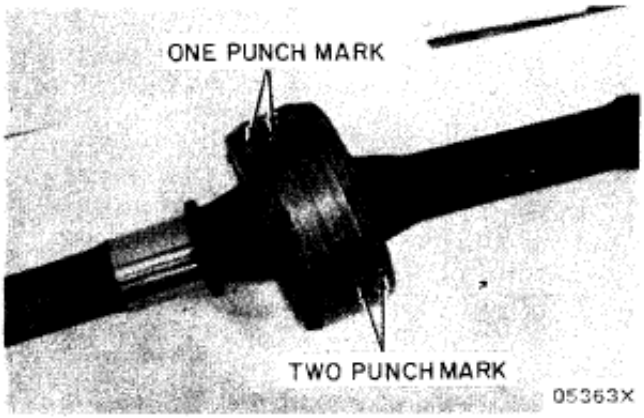
2. NOTE: If faulty condition exists or excessive wear is indicated, it is recommended that the axle shaft be replaced as an assembly.

Check axle shaft splines for damage, cracks or wear. Check axle shaft journal (area that contacts bushing in axle ball) for scoring or excessive grooving. Check for excessive clearance between axle shaft yoke trunnions and cage rings. If excessive clearance (greater than 0.050") is suspected, disassemble axle shafts as follows and measure clearance.

3. IMPORTANT: Punch mark cage rings and yoke trunnions for identification in reassembly (see photo). If axle shaft parts are to be reused, the trunnions must be replaced in the original cage ring holes to assure correct operation.



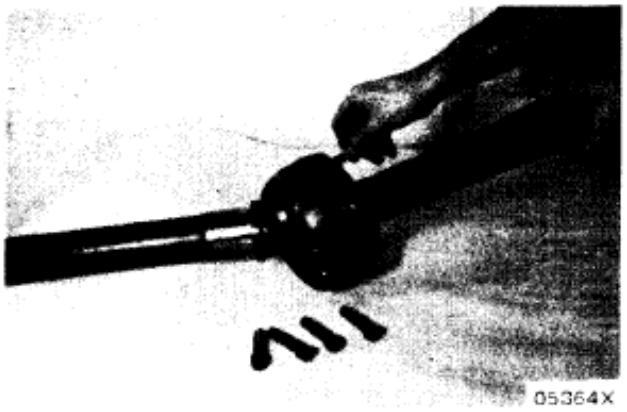
Removing Axle Shaft Assembly.



Identifying Cage Rings.

Disassembly (Cont'd)

4. To disassemble, remove socket screws from both sides of cage rings then separate ring halves and shafts (see photo).



Separating Cage Rings.

5. Using suitable gauges, measure trunnion diameters and their mounting holes in the cage rings. If clearance is greater than 0.050", it is recommended that axle shaft assembly be replaced.

Measuring Trunnions and Mounting Holes.

Remove and Disassemble Axle Ball and Socket

1. Disconnect tie rod ends or remove tie rod assembly as follows:

Right-Hand Wheel End: Remove cotter pin, nut and flat washer from ball stud at ball socket. Disconnect the tie rod end. With rod end disconnected, the tapered coil spring, seal cover, rubber seal washer and flat washer can be removed from the ball stud.

Left-Hand Wheel End: Disconnect tie rod end using same procedures as described above for right-hand wheel end.

Also, disconnect steering drag link from ball stud mounted in steering arm at top of ball socket.

2. As the ball socket is disassembled, identify socket and related parts location to insure that these parts will be returned to their original positions.

3. Remove ball seal retainer cap screws and lockwashers, then carefully pry retainer and seal from its mounting (see photo).

Removing Seal and Retainer.

Disassembly (Cont'd)

4. Remove kingpin covers as follows:

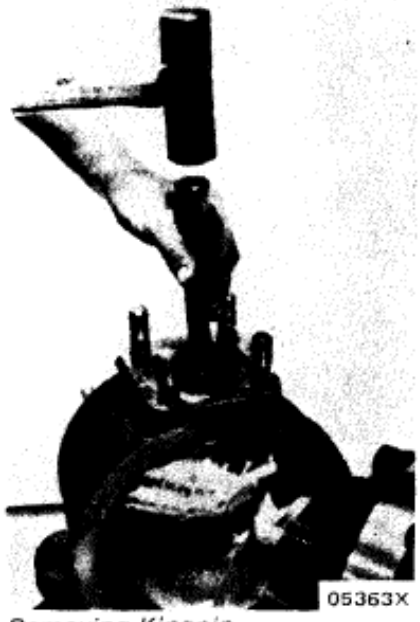
Left-Hand Wheel End: Remove nuts, lockwashers and dowels (tapered split type) from steering arm and top cover (see photo). Remove cap screws and lockwashers from bottom cover. Remove covers and shims. Identify shims removed.

Right-Hand Wheel End: Remove nuts and lockwashers from top kingpin bearing cover and cap screws and lockwashers from bottom cover. Remove covers and shims. Identify shims removed.

Removing Kingpin Top Cover.

5. Remove cotter pins, nuts and spacers from kingpins. Using suitable drift, drive kingpins out of their bearings and mounting in the axle ball.

IMPORTANT: Exercise care not to damage kingpin threads during above procedure.



Removing Kingpin.

6. While keeping the kingpin bearing cones fully seated in their cups, carefully drive the ball socket down until the upper bearing cup is moved up at least 1/8" above the bearing cover parting line. Repeat same procedure for lower kingpin bearing.

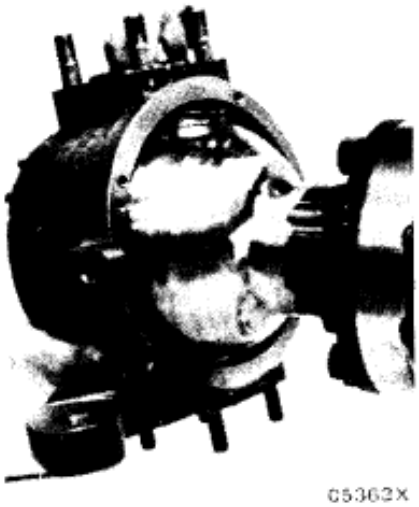
Partially Removing Top Bearing Cup.

Disassembly (Cont'd)

7. Remove ball socket as follows:
Hold upper kingpin bearing cone up in its full mounting position in its cup, then tip ball socket and remove it from the axle ball (see photo).

NOTE: With ball socket removed, the bearing cones can be removed. The upper and lower bearings vary in size. Take note of their location to assure their return to original positions.

8. Remove axle ball as follows:
Remove nuts, cap screws and lockwashers fastening flange to axle housing. Remove ball.



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Removing Ball Socket.

Inspect Axle Ball, Socket and Related Parts

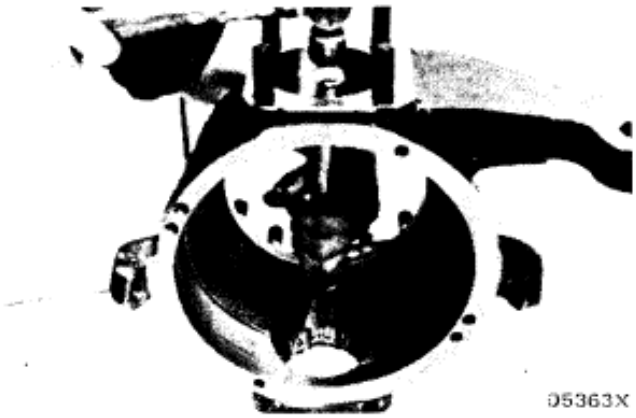
1. Inspect ball for deep grooves or scratches. Check clearance between ball bushing and journal area (on axle shaft) that contacts bushing. If clearance exceeds 0.015", replace ball and bushing assembly.

2. Inspect oil seal in bore of ball for defects. If faulty, replace the seal. Remove with suitable puller.

3. Inspect kingpin bearings for pitted or worn rollers or cup surfaces, and other faulty condition. Replace as a set (bearing cone and cup). Inspect kingpins for wear. Replace worn kingpins.

4. If replacement is necessary, remove bearing cup from ball socket using suitable driver (see photo). The bearing cups vary in size. When removing, take note of cup location so they can be returned to their original position.

5. Inspect camshaft bushings (in ball socket) for wear as follows: Install camshaft in bushings and check side movement with dial indicator. If movement is greater than 0.020", replace oil seals, bushings and/or camshaft. To remove bushings, drive them out of ball socket using a suitable driver.



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Removing Kingpin Bearing Cup.

Assemble Ball Socket

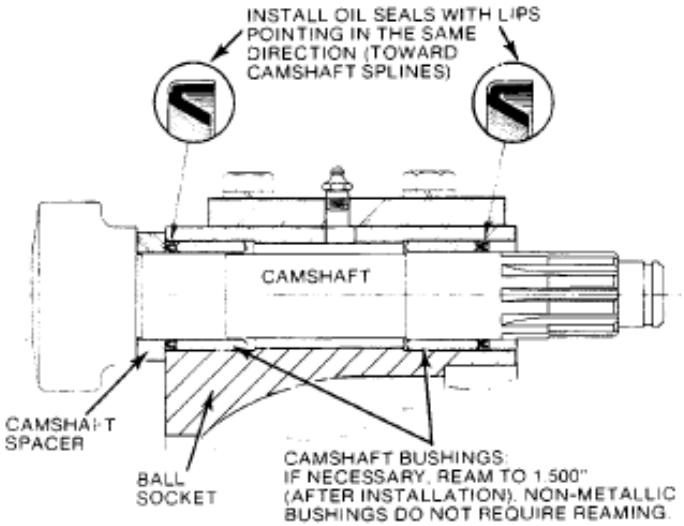
1. If camshaft bushings are to be replaced, proceed as follows to install new bushings:

Install bushings, using suitable driver. (Ream bronze bushings to 1.500" after installation. Non-metallic bushings do not require reaming. They are presized at the factory).

2. If camshaft oil seals are faulty or were removed, install new seals as follows:

Use suitable driver to install seals.

IMPORTANT: Molded lip-type seals must be installed with both lips pointing in the same direction (see drawing). Failure to install seals properly may result in oil-soaked brake linings or blowing out the seals.


INSTALL OIL SEALS WITH LIPS POINTING IN THE SAME DIRECTION (TOWARD CAMSHAFT SPLINES)
CAMSHAFT
CAMSHAFT SPACER
BALL SOCKET
CAMSHAFT BUSHINGS: IF NECESSARY, REAM TO 1.500" (AFTER INSTALLATION). NON-METALLIC BUSHINGS DO NOT REQUIRE REAMING.

Camshaft Bushing and Oil Seal Installation.

Assemble Axle Ball

1. If ball bushing (for axle shaft) is to be replaced, install new bushing as follows:

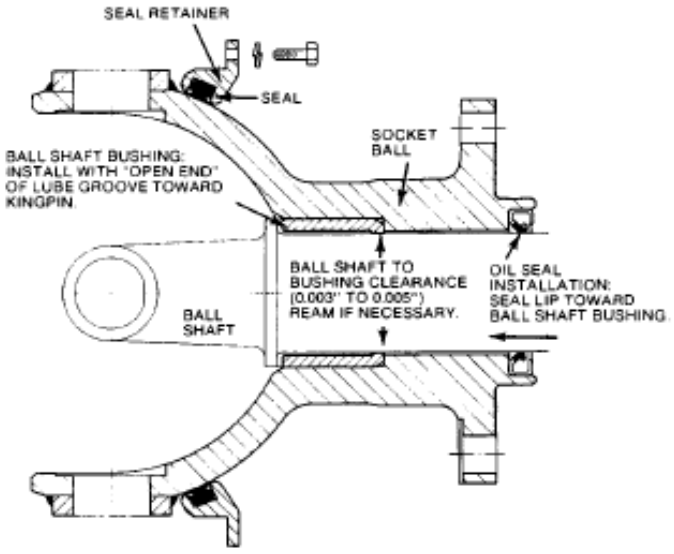
Position bushing in axle ball with chamfered end down and the open end of lube groove facing up or towards the outside of the axle ball (see drawing).

After installation, check shaft journal to bushing clearance.

IMPORTANT: A clearance of 0.003" to 0.005" is imperative. If necessary, ream bushing to maintain this clearance.

2. If oil seal is faulty or has been removed, install a new seal.

NOTE: Position seal with sealing lip toward ball bushing (see drawing). Seal should seat firmly against shoulder in mounting bore of ball.


SEAL RETAINER
SEAL
SOCKET BALL
BALL SHAFT BUSHING: INSTALL WITH "OPEN END" OF LUBE GROOVE TOWARD KINGPIN.
BALL SHAFT TO BUSHING CLEARANCE (0.003" TO 0.005") REAM IF NECESSARY.
OIL SEAL INSTALLATION: SEAL LIP TOWARD BALL SHAFT BUSHING.
BALL SHAFT

Ball Bushing and Oil Seal Installation.

Install Axle Ball on Axle Housing

1. Place axle ball on axle housing studs. Install nuts and lockwashers. Install cap screws and lockwashers.

Torque nuts to 280-360 ft-lbs. (380-488 N·m). Torque cap screws to 170-220 ft-lbs. (231-298 N·m).

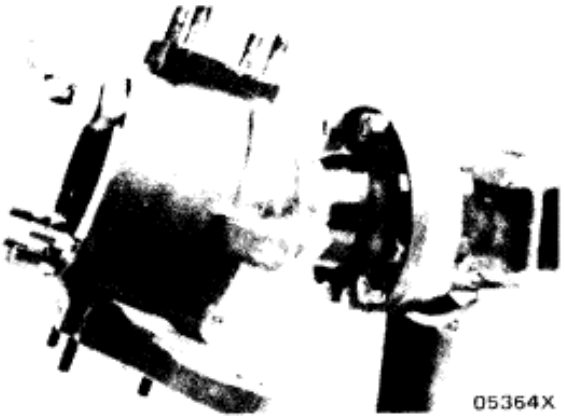
Assembly

Assemble Socket to Axle Ball

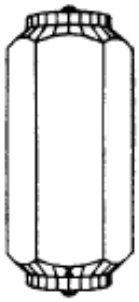
1. Tip axle ball socket (see photo), and install it on the axle ball. Position socket on ball to maintain correct relationship between top and bottom of the ball and socket.

2. Install Kingpins: A special spreading fixture is recommended for installation of kingpins. This tool can be obtained from:

Oshkosh Truck Corporation
2307 Oregon St.
Oshkosh, Wisconsin 54903



Installing Axle Ball Socket.



Kingpin Spreading Fixture.

Position kingpins and spreading fixture in ball socket, engaging fixture pins with head of kingpins. (Adjust fixture nut until kingpins are seated in their mounting holes.)

IMPORTANT: Leave fixture in position until Steps 2 thru 10 are completed.

3. Install upper kingpin bearing cone using suitable driver (driver should only contact inner race of cone).

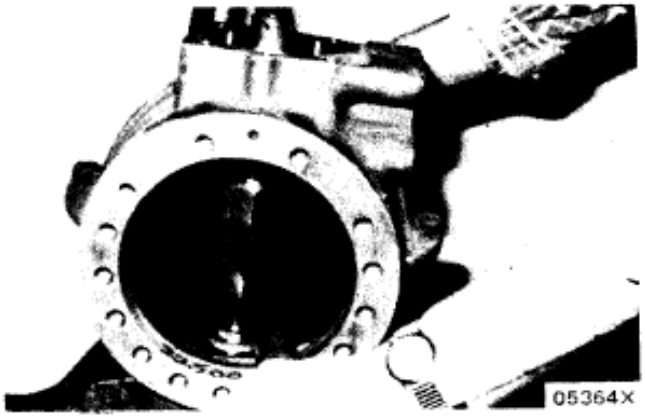
NOTE: The upper bearing cone has a smaller outside diameter than the lower cone. Make certain correct cone is installed.

4. Install upper bearing cup using suitable driver (see photo). Tap cup into mounting position until it is flush with the kingpin cover surface.

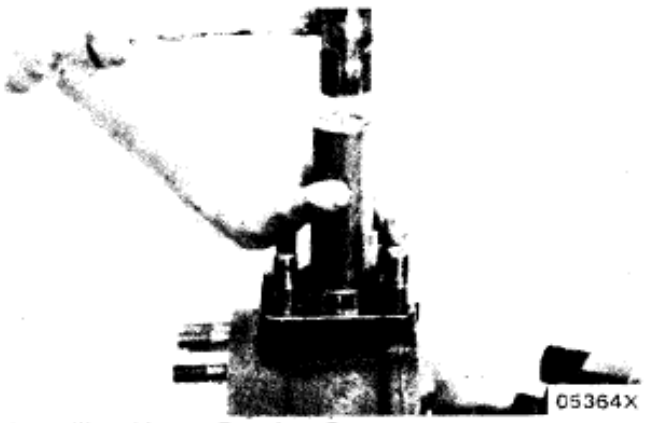
NOTE: The upper cup has a thicker wall as compared to the lower cup. Make certain the correct cup is installed.

5. Install lower bearing cone and cup using same procedures in Step 3 and 4.

6. Install kingpin spacers and nuts. Tighten nuts to 500 ft-lbs. (680 N·m). Continue tightening nut until cotter pin hole lines up with nut slot. Install cotter pin.



Adjusting Kingpin Spreading Fixture.



Installing Upper Bearing Cup.

Assemble Socket to Axle Ball *(Cont'd)*

7. Install kingpin bearing covers and shims (top and bottom):

On the left-hand wheel end, the top cover includes the steering arm and is fastened with dowels, nuts and lockwashers. The bottom cover uses cap screws and lockwashers.

On the right-hand wheel end, the top cover uses nuts and lockwashers. The bottom cover uses cap screws and lockwashers.

NOTE: If original parts are used in reassembly, install the shims (spacers) previously removed and identified during disassembly. If new parts are used, place a shim pack of 0.045" under each kingpin bearing cover. Shim location may be changed from upper to lower position (or vice versa) to properly center the axle ball within the socket.

8. Install kingpin covers and shims (spacers) previously removed and identified during disassembly. If new parts are used, place a shim pack of 0.045" under each kingpin bearing cover. Shim location may be changed from upper to lower position (or vice versa) to properly center the axle ball within the socket.

NOTE: The kingpin spreading fixture is still installed and will affect the drag.

9. Lubricate both bearings (using wheel bearing grease and a gun). Operate gun until grease can be seen coming out of bearing cones.

10. Remove the kingpin spreading fixture and tighten top cover nuts to correct torque (see chart below).

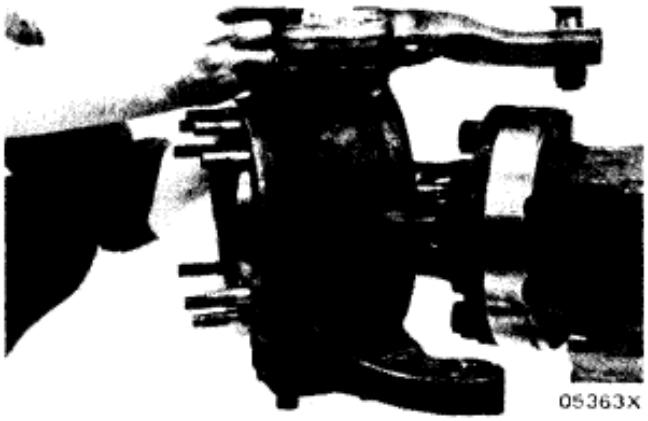
NOTE: At this point of assembly, check bearing preload (or drag of axle socket movement on the ball). A pull of approximately 38 to 42 lbs. should be required to continue (not start) the socket movement on the ball. Add or reduce shims to obtain proper bearing preload.

In operation, the socket should not contact or rub the ball at any position between the extreme range of its travel. Adjust socket and ball position by exchanging shims between top and bottom covers.

It is recommended that some shims be left in both upper or lower position. No cover should be installed without at least one shim. In some instances, it may be necessary to grind a small amount of the socket away to provide necessary clearance and still maintain a minimum of one cover shim.

11. With ball adjusted properly, apply lubricant in the trough formed on the back side of the socket (between socket and ball). Remove grease fitting from lower bearing cover and install a pipe plug.

King Pin Cover Torque Chart		
Cap Screws	170-220 ft-lbs.	231-298 N·m
Nuts	280-360 ft-lbs.	380-488 N·m



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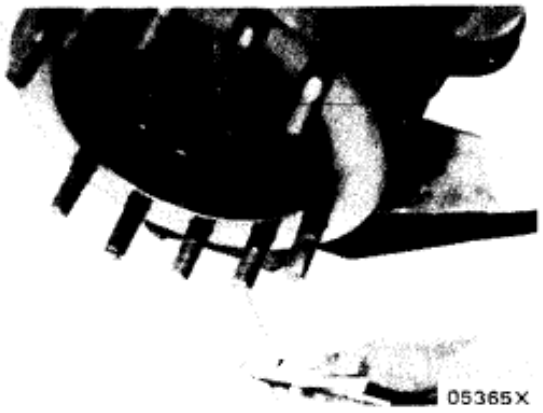
Installing Kingpin Top Cover and Steering Arm.



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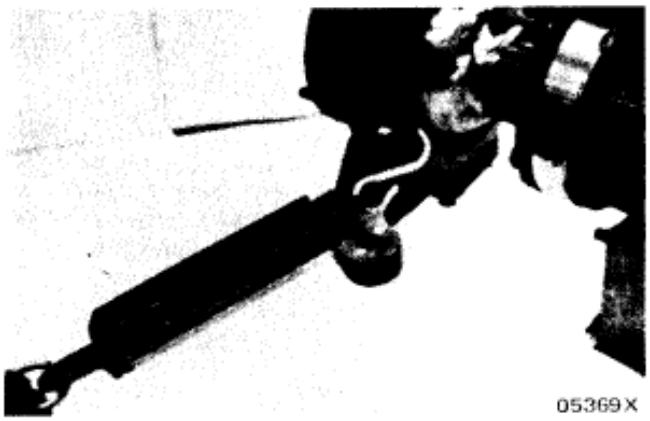
Lubricating Kingpin Bearings.



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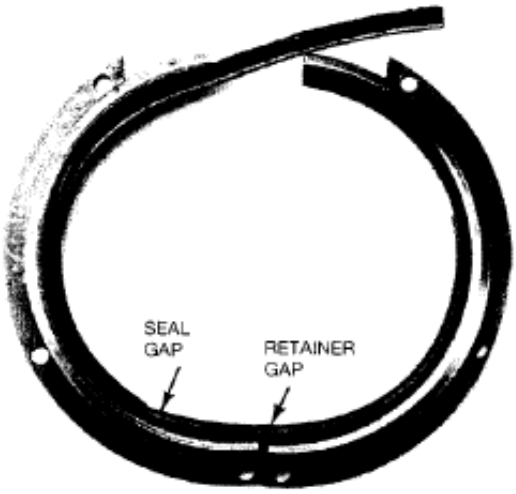
Checking Kingpin Bearing Preload.

Assembly

Install Axle Ball Seal and Retainer

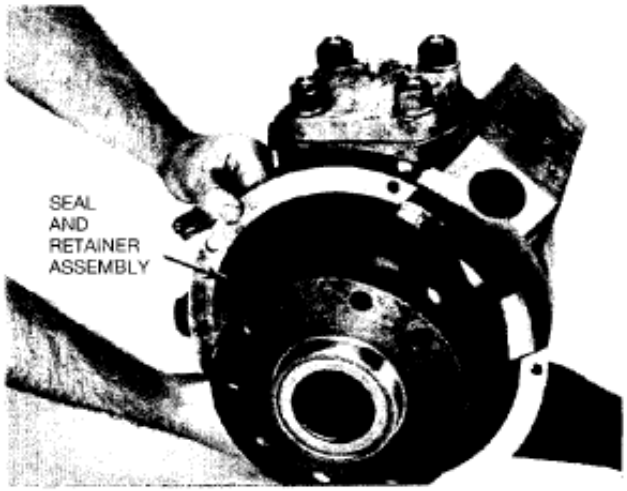
1. Ball seal retainer halves are furnished in matched sets and are identified by matching numbers *stamped* on the retainer faces. First, assemble seal and retainers as follows: Place both retainer halves in a vise so they form a complete circle. Install seal in retainer with seal gaps away from retainer gaps (see photo). Trim or cut off seal at a slight angle so that the seal ends join together.

NOTE: Lubricate seal lip with grease.



Seal and Retainer Assembled.

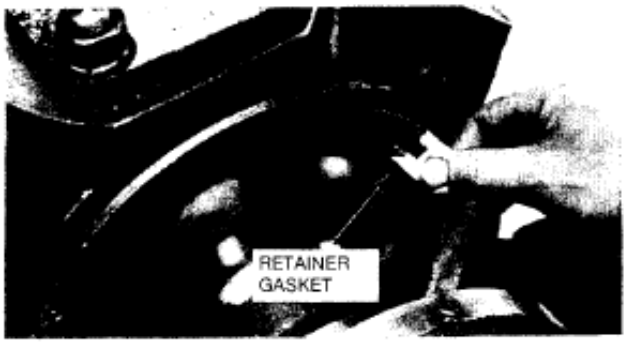
2. To install seal and retainer assembly on axle, remove from vise. Then open one split in seal and retainer then slide retainer and seal over the axle ball (see photo). Join the retainer halves.



Installing Seal and Retainer Assembly.

3. To correctly position retainer, push it towards the socket and just before it is in place (and while a gap between halves still exists), insert two retainer gaskets (see photo). Complete installation by tapping retainer in place and installing cap screws and lockwashers.

4. Turn axle ball to one extreme and coat inside area of socket with grease. Turn axle ball to one extreme and coat inside area of socket with grease. Turn ball to opposite extreme and lubricate ball with grease.



Installing Retainer Gasket.

Adjust Steering Stop Screws

1. If removed, install stop screw and locknut (screw head should face axle ball) in ball socket.

2. Steering stop screws should be adjusted to limit a 22° angle turn in either direction. A plate, fabricated with a 22° angle (see illustration), will help in making this adjustment.

3. Adjusting Steering Stop (see illustration). To use the fabricated 22° angle plate and adjust stop screw, proceed as follows:

a. Remove the two top cap screws fastening ball to axle housing.

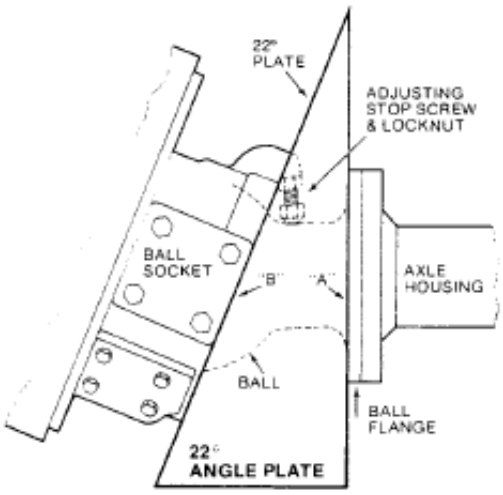
b. Position plate between ball flange surface "A" and ball socket surface "B". With socket in this position, adjust stop screw until it touches the ball.

c. Tighten locknut to secure stop screw.

d. Install axle ball to housing cap screws. Torque cap screws to 170-220 ft-lbs. (231-298 N·m).

NOTE: Use same procedure for both left and right-hand wheel ends.

NOTE: In service, the Pitman arm stops should be set to limit wheel cut before adjusting stop screw contacts on axle ball.



Adjusting Steering Stop.

Assemble Axle Shaft and Cage Ring Assembly

1. If axle shaft and cage ring were disassembled, proceed as follows:

Place a thin layer of lubricant on shaft yoke trunnions and their mounting holes in the cage rings.

With cage rings and shaft yokes in correct position (marked for position during disassembly), engage rings and shaft yokes. Install socket head cap screws.

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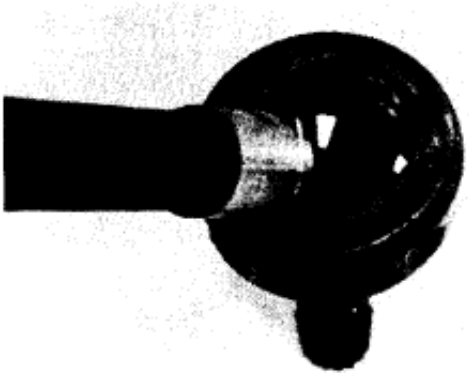
Assembling Cage Rings.

2. Referring to the photograph, check for correct assembly. Note the relationship of the relieved shape of cage ring and shaft yokes. Rotate shaft assembly and note movement angle. The shafts should be able to move freely 30° to both sides during a 360° revolution. Torque screws to 95 ft-lbs. (130 N·m). Lock screws with punch marks across threaded end of cap screws.



05366X

Checking Axle Shaft Movement Angle.

Assembly

Install Axle Shaft Assembly

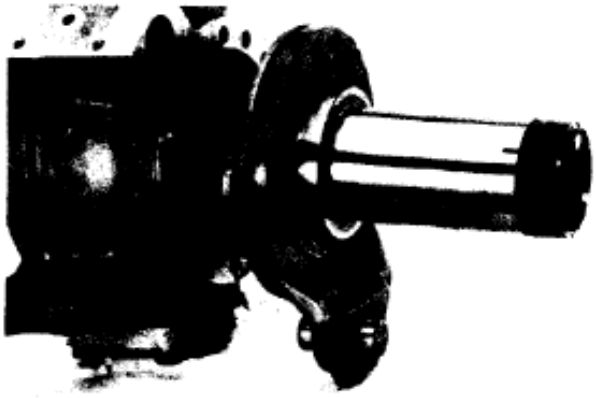
1. Turn ball socket to straight ahead position. Grease axle shaft bushing (in axle ball) and pack inner walls of axle ball with 3/4" layer of grease. Be sure to leave an opening for installing axle shaft.

2. If necessary, polish axle shaft spline ends to eliminate possible nicks or burrs. Nicks or burrs could damage axle shaft oil seal (located in axle ball). Lubricate axle shaft polished surfaces. Install axle shaft, being careful not to damage oil seal or bushing in axle ball. As shaft is installed, use extra grease (forced out of ball) to completely coat the cage ring.

Installing Axle Shaft Assembly.

Install Brake Spider and Spindle

1. Place spider on shoulder at axle side of spindle, then place this assembly on ball socket. Fasten with cap screws. Tighten screws to torque of 170-220 ft-lbs. (231-298 N·m).



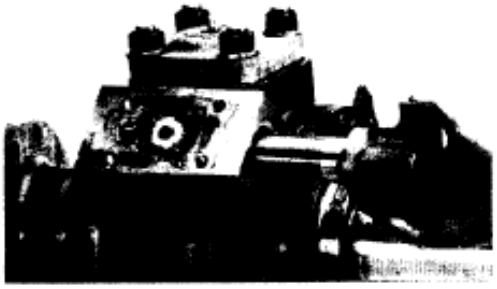
Installing Brake Spider and Spindle.

Install Brake Camshaft, Slack Adjuster and Adjust End Play

1. Place light coating of grease on camshaft bushing journals. Place spacer on camshaft (next to cam). Install camshaft in ball socket. Install washer, slack adjuster and shims on splined end of camshaft. Secure with snap ring.

2. Adjust camshaft end play (between 0.005" and 0.045") by adding or removing shims between snap ring and slack adjuster.

Installing Brake Camshaft.



Installing Slack Adjuster.

Adjust Air Chamber Push Rod Length

1. NOTE: Before installing air chamber, check push rod length.

Push rod length should be 2-5/8" ± 1/16" (66.5 ± 1.5mm). Measure distance from mounting face of air chamber to centerline of clevis pin hole. To adjust, loosen locknut and turn clevis on push rod.

NOTE: After adjustment is made, make sure push rod does not project into clevis more than two threads.

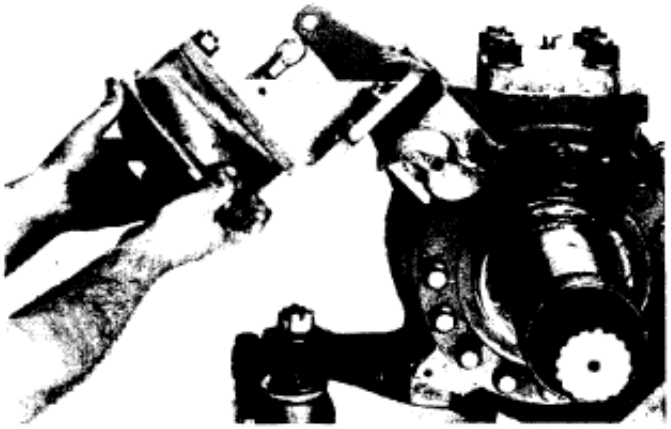
Install Air Brake Chamber and Lubricate Camshaft Bushings

1. Install air chamber and mounting bracket assembly on ball socket. Secure with cap screws and lockwashers. Torque to 80-110 ft-lbs. (110-149 N·m). Connect slack adjuster arm to air chamber clevis. Install clevis pin and cotter pin.

2. Pressure lubricate camshaft bushings with chassis lube (through fitting in brake chamber bracket). Continue filling lube until excess or overflow is evident at slack adjuster.

NOTE: Lube overflow should not be seen at "S" cam if oil seals have been properly installed.

3. After adjusting air chamber free stroke (see below), place slack adjuster guard in mounting position on air chamber, and secure with flat washers, lockwashers and cap screws.



Install Air Chamber and Bracket Assembly.

Adjust Air Chamber Push Rod Free Stroke

1. Air chamber free stroke is the movement of the push rod from the released to the applied brake positions.

To determine free stroke, first measure the distance with brake released.

Apply brakes using a lever to rotate slack adjuster, and repeat the measurement.

Subtract the released dimension from the applied dimension to obtain free stroke.

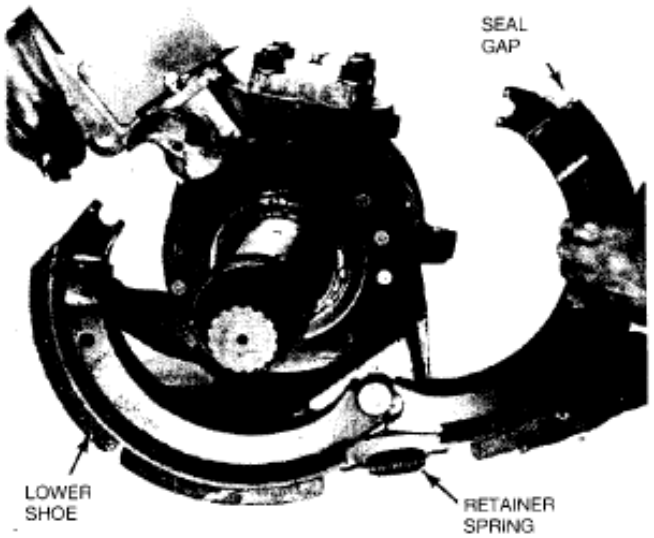
Free stroke should be 1/2 - 5/8 in. (12.7 - 15.9 mm). If free stroke is not within specifications, depress locking sleeve on slack adjuster and adjust as required.

Assembly

Install Brake Shoes

NOTE: When brake shoes are relined, use new shoe retainer and return springs in reassembly. When reusing brake shoes, be sure to place them in their original location as identified in disassembly.

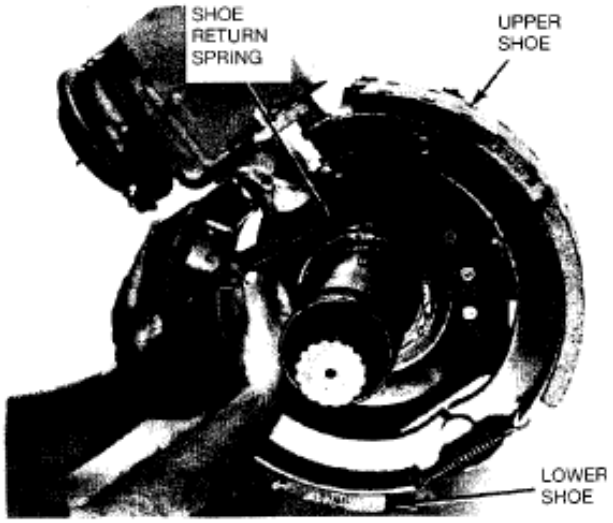
IMPORTANT: Leading and trailing brake shoe linings may vary with air chamber mounting. Make sure brake shoes are properly installed (see Brake Reline, page 1-11).



Positioning Shoes on Anchor Pin.

1. To install brake shoes, attach retainer springs to both shoes, then position shoes on anchor pin (see photo).

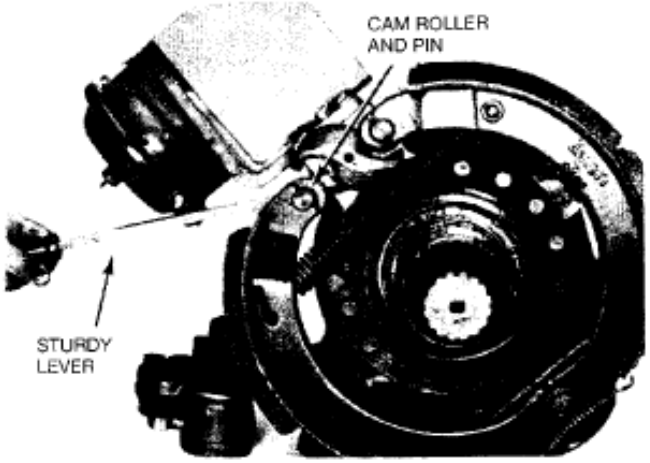
2. With both shoes in mounting position, attach return spring to upper shoe. Lift lower shoe and connect spring to shoe pin (see photo).



Connecting Shoe Return Spring.

3. Pry down on lower shoe (with a sturdy lever, see photo), and install cam roller and pin. Repeat procedure for upper shoe.

⚠ **WARNING:** To avoid possibility of personal injury, make certain you have a firm grip on prying lever before installing roller and pin.



Prying Down on Brake Shoe to Install Cam Roller and Pin.

Connect Tie Rod and Steering Drag Link

1. If tie rod end was disconnected from axle ball socket, proceed as follows: Install flat washer, seal washer and tapered coil spring on tie rod end ball stud. Connect stud to ball socket and secure with slotted nut. Torque to 450 ft-lbs. (613 N·m) and install cotter pin.

On left-hand wheel, connect tie rod end using same procedure as above. Also connect steering drag link to upper kingpin cover steering arm.

NOTE: Refer to Wheel Alignment Section for tie rod adjustment.

Tie Rod End Replacement

IMPORTANT: When tie rod ends are replaced, they must be threaded into the tie rod sufficiently so that when the clamp is applied, the clamping action will be directly over the threads on the ball joint end. Be sure that the end is in far enough (past the clamp) to provide adequate clamping and the bolt in the clamp is installed next to (over) the slot in the tie rod. Torque the clamp bolt to 60-80 ft-lbs. (81-110 N·m).

Assemble and Install Wheel Hub and Drum

NOTE: During the following assembly procedure, use wheel bearing grease (see Lubrication Section).

1. If bearing cups were removed from hub, install with suitable driver. Install cups until they seat firmly on shoulder inside hub.

2. Line entire wall of hub with grease. Fill hub with grease leaving only an opening large enough for the spindle to pass through.

3. Pack bearing cones with grease. Install inner bearing cone in hub. Install bearing spacer on cone with chamber (at inner diameter) facing out.

4. Install oil seal in hub using suitable driver or press. Press seal into hub until it is flush with face of the hub.

05368X

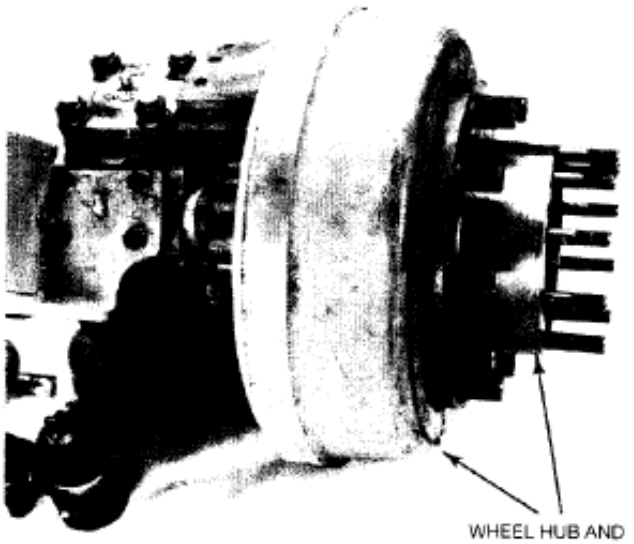
Installing Bearing Cone and Spacer.

05367X

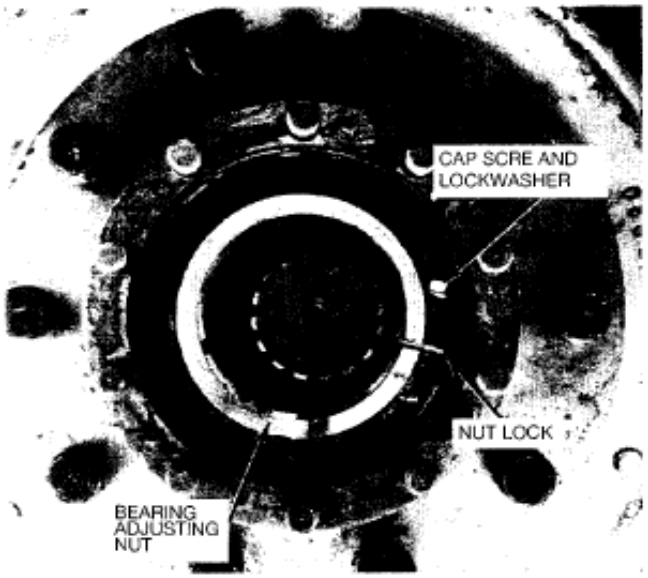
Installing Hub Oil Seal.

Assembly

Assemble and Install Wheel Hub and Drum *(Cont'd)*



Installing Wheel Hub and Drum.



Wheel Bearing Adjusting Nut.

5. Install hub and drum on spindle. Install outer bearing cone.

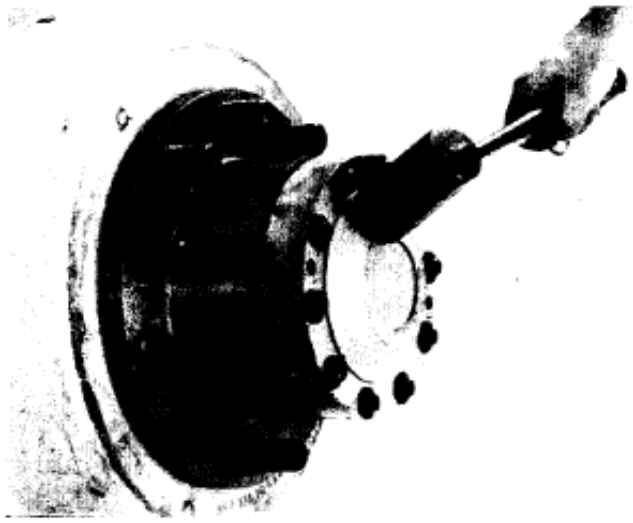
6. Install wheel bearing adjusting nut. Tighten nut to seat the bearings. Rotate drum while tightening nut. After nut is seated firmly against bearing cone, back off until the slot in the adjusting nut aligns with slot (or groove) in axle spindle.

NOTE: Bearing adjustment is important. The nut should be tight enough to eliminate hub end play and create a slight hub drag. Drag should produce a 4 to 10 lbs. pull at wheel mounting studs. If drag is incorrect, reset adjusting nut.

7. After bearing adjustment is correct, install the nut lock in the adjusting nut slot. Install cap screw and lockwasher in the nut to hold lock and adjusting nut in position.

8. Pack groove in hub cap with grease (1/2" thick layer).

9. Using a soft-nosed hammer, install hub cap and secure with nuts and lockwashers. Tighten nuts to 170-220 ft-lbs. torque (231-298 N·m).



Installing Hub Cap.

Install Wheels and Tires, Lubricate Axle

1. Install wheels and tires.

2. Fill Axle with correct lubricant (refer to Lubrication Section).

3. Check wheel alignment (refer to Wheel Alignment Section).

Single Reduction, Dual Range, Double Reduction

Differential Carriers

These instructions cover service and maintenance for the steer-drive axle differential carrier. For information on single reduction gearing with Spicer Controlled Traction Differential, refer to Section 7.

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Lubrication

The ability of a drive axle to deliver quiet, trouble-free operation over a period of years is largely dependent upon the use of good quality gear lubricant in correct quantity. The most satisfactory results can be obtained by following the directions contained in this book.

Approved Lubricants

Multigrade gear lubricants which meet the requirements of military specification MIL-L-2105-C are recommended for use in Spicer drive axles. These lubricants perform well over broad temperature ranges, providing good gear and bearing protection in a variety of climates. The MIL-L-2105-C specification divides lubricants into three major categories on the basis of lube viscosity at various temperatures. These are 75W, 80W-90 and 85W-140. 80W-140 lubricants are also available, but are listed with 80W-90 by MIL-L-2105-C. Lubricants approved under MIL-L-2105-B are also acceptable for use in Spicer Axles.

Synthetic Lubricants: Use of synthetic lubricants in Spicer Axles is approved only after Engineering Department review. This is essential to ensure proper seal life and axle performance with a particular synthetic. For additional information, contact Spicer Field Service Department, or call Regional Office. See back cover for address and phone numbers.

Oil Additives: The use of oil additives is *not* approved for use in Spicer axles.

Choosing the Correct Gear Lube

Axle gear lube should be selected on the basis of the ambient temperature range in which the vehicle normally operates. This should also be considered whenever changes in vehicle location or primary operating area are made, and the grade of lube changed if necessary.

Ambient Temperature Range	Proper Grade
-40° F to -15° F (-40° C to -26° C)	75W
-15° F to 100° F (-26° C to 38° C)	80W-90
-15° F and above (-26° C and above)	80W-140
10° F and above (-12° C and above)	85W-140

Lube Change Intervals

Initial Change: The lube in a new or rebuilt axle should be changed within the first 5000 miles of operation. This will remove fine particles of wear material generated during break-in and prevent accelerated wear on gears and bearings.

Subsequent Changes: Subsequent lube changes should be made at 100,000-mile intervals for Class "A" or "AA" highway operation.

Class "A" operation is defined as well-maintained highways of concrete or asphalt construction. Terrain level to rolling with maximum 8% grades. Class "AA" is turnpike. For other type operations, change lube at 40,000-mile intervals.

If the vehicle does not accrue enough mileage to require a lube change, change the lubricant once yearly.

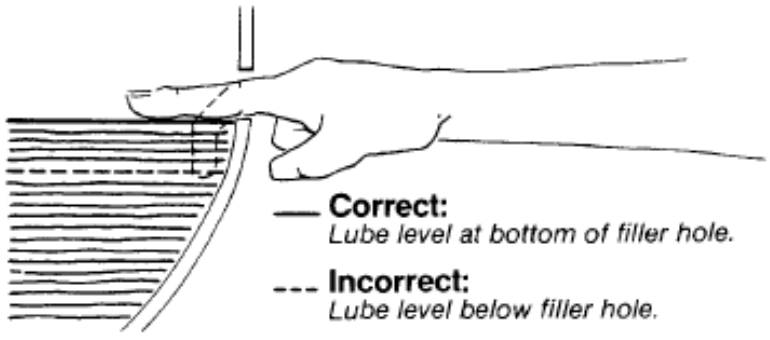
Adding Lube: If the lube level falls below its proper level between changes, it should be replenished as needed. Lubricants approved under the MIL-L-2105-C specification are compatible with each other and brands may be mixed. To maintain proper viscosity levels, however, do not mix lube grades when adding to an existing supply.

Checking Lube Level

Remove the filler hole plug located in the axle housing cover. Lube should be level with the bottom of this hole.

IMPORTANT: Lube level close enough to the hole to be seen or touched is not sufficient. It must be level with the hole.

NOTE: When checking lube level, also check and clean housing breathers.



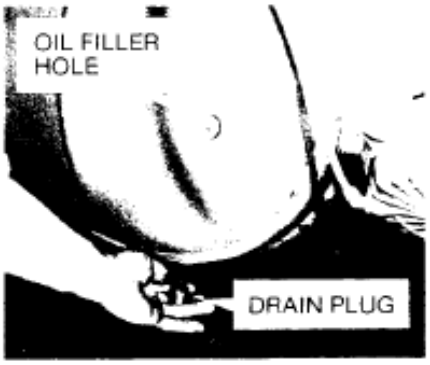
Changing Lube

Draining

Drain when the lube is at normal operating temperature. It will run freely and minimize the time necessary to fully drain the axle.

Unscrew the magnetic drain plug on the underside of the axle housing and allow the lube to drain into a suitable container. Inspect drain plug for large quantities of metal particles. After initial oil change, these are signs of damage or extreme wear in the axle, and inspection of the entire unit may be warranted. Clean the drain plug and replace it after the lube has drained completely.

Axles with Lube Pump: Remove the magnetic strainer from the power divider cover and inspect for wear material in the same manner as the drain plug. Wash the magnetic strainer in solvent and blow dry with compressed air to remove oil and metal particles.



Filling

Remove the filler hole plug from the center of the axle housing cover and fill the axle with approved lubricant until level with the bottom of the hole.

Lube Capacity
DO NOT OVERFILL AXLE

ESD-18
Steer-Drive Axle . . . 36 pints (17 liters)

NOTE: Lube fill capacities in the adjacent chart are good guidelines but will vary somewhat on the basis of the angle the axle is installed in a particular chassis.

Always use the filler hole as the final reference. If lube is level with the bottom of the hole, the axle is properly filled.

Axles installed at angles exceeding 10 degrees or operated in areas of continuous and lengthy grades may require standpipes to allow proper fill levels.

Contact Spicer Field Service Department, or call Regional Office for specific recommendations. See back cover for address and phone numbers.

As the drive axle is disassembled, set all parts aside for thorough cleaning and inspection. Careful inspection will help determine whether parts should be reused. In many cases, the causes of premature wear or drive axle failure will also be revealed.

Cleaning

The differential carrier assembly may be steam-cleaned while mounted in the housing as long as all openings are tightly plugged. Once removed from its housing, do not steam clean differential carrier or any components. Steam cleaning at this time could allow water to be trapped in cored passages, leading to rust, lubricant contamination, and premature component wear. The only proper way to clean the assembly is to disassemble it completely. Other methods will not be effective except as preparatory steps in the process. Wash steel parts with ground or polished surfaces in solvent. There are many suitable commercial solvents available. Kerosene and diesel fuel are acceptable.

⚠ **WARNING:** GASOLINE IS NOT AN ACCEPTABLE SOLVENT BECAUSE OF ITS EXTREME COMBUSTIBILITY. IT IS UNSAFE IN THE WORKSHOP ENVIRONMENT.

Wash castings or other rough parts in solvent or clean in hot solution tanks using mild alkali solutions. If a hot solution tank is used, make sure parts are heated thoroughly, before rinsing.

Rinse thoroughly to remove all traces of the cleaning solution. Dry parts immediately with clean rags.

Lightly oil parts if they are to be reused immediately. Otherwise, coat with oil and wrap in corrosion-resistant paper. Store parts in a clean, dry place.

Inspection

Inspect steel parts for notches, visible steps or grooves created by wear. Look for pitting or cracking along gear contact lines. Scuffing, deformation or discoloration are signs of excessive heat in the axle, usually related to low lubricant levels or improper lubrication practices.

Before reusing a gear set, inspect teeth for signs of excessive wear. Check tooth contact pattern for evidence of incorrect adjustment (see Adjustment Section for correct pattern).

Inspect machined surfaces of cast or malleable parts. They must be free of cracks, scoring, and wear. Look for elongation of drilled holes, wear on surfaces machined for bearing fits and nicks or burrs in mating surfaces.

Inspect fasteners for rounded heads, bends, cracks or damaged threads.

The axle housing should be examined for cracks or leaks. Also look for loose studs or cross-threaded holes.

Inspect machined surfaces for nicks and burrs.

Repair and Replacement

IMPORTANT: To achieve maximum value from an axle rebuild, replace lower-cost parts, such as thrust washers, seals, and bushings. These items protect the axle from premature wear or loss of lubricants. Replacing these parts will not increase rebuild cost significantly.

It is also important to replace other parts which display signs of heavy wear even though not cracked or broken. A significant portion of such a part's useful life has been expended and the damage caused, should the part fail, is far in excess of its cost.

Steel Parts — Gear sets, input and output shafts, differential parts and bearings are not repairable. Worn or damaged parts should be discarded without hesitation. Also discard mating parts in some cases. Gear sets for example, must be replaced in sets.

Miscellaneous Parts — Seals and washers are routinely replaced. None of these parts can be reused if damaged. Fasteners using self-locking nylon "patches" may be reused if not damaged, but should be secured by a few drops of Loctite #277 on the threaded surface of the hole during installation and carefully torqued during installation.

Axle Housings — Repairs are limited to removal of nicks or burrs on machined surfaces and the replacement of loose or broken studs.

CAUTION: ANY DAMAGE WHICH AFFECTS THE ALIGNMENT OR STRUCTURAL INTEGRITY OF THE HOUSING REQUIRES HOUSING REPLACEMENT. REPAIR BY WELDING OR STRAIGHTENING SHOULD NOT BE ATTEMPTED. THIS PROCESS CAN AFFECT THE HOUSING HEAT TREATMENT AND CAUSE IT TO FAIL COMPLETELY WHEN UNDER LOAD.

Silicone Rubber Gasket Compound — For more effective sealing, Spicer uses silicone rubber gasket compound to seal the majority of metal-to-metal mating surfaces.

Spicer includes gasket compound and application instructions in many repair parts kits.

It is recommended that this compound be used in place of conventional gaskets. The compound will provide a more effective seal against lube seepage and is easier to remove from mating surfaces when replacing parts.

Always use Spicer Genuine Axle Parts and Parts Kits.

Genuine Spicer replacement parts are the same high quality tolerances as the original axle components and include the latest engineering improvements.

Parts Kits have only one part number which makes ordering, stocking and servicing easier. They are not only convenient, but give the advantage of having every part needed for a good repair job.

Differential Carrier

Bearing Preload: This adjustment is performed for both pinion and differential bearings. It maintains proper gear alignment by creating correct bearing cone and cup relationship for free rotation under load. The pinion pilot bearing does not require a preload adjustment.

Ring Gear Tooth Contact: This adjustment positions ring gear and pinion for best contact under load. Correct adjustment distributes torque evenly over gear teeth and helps maximize gear set life.

Adjust Pinion Bearing Preload for Axles with "Press-fit" Outer Pinion Bearings

Trial Build-up

1. Assemble pinion bearing cage, bearings and spacer (without drive pinion or oil seal). Center bearing spacer between two bearing cones.

NOTE: When new gear set or pinion bearings are used, select nominal size spacer from the specification chart below. If original parts are used, use spacer removed during disassembly.

2. With the bearings well lubricated, place the assembly in the press. Position sleeve so that load is applied directly to the back-face of the outer bearing cone.

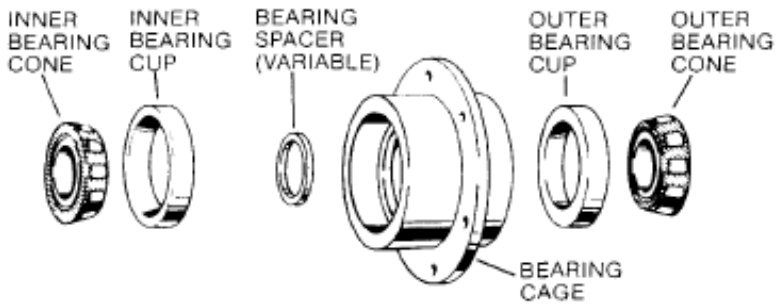
3. Apply press load (see chart below) to the assembly and check rolling torque. Wrap soft wire around the bearing cage, attach spring scale and pull. Preload is correct when torque required to rotate the pinion bearing cage is from 10-20 inch-pounds. This specification is translated into spring scale readings in the chart below.

4. If necessary, Adjust Pinion Bearing Preload by changing the pinion bearing spacer. A thicker spacer will decrease preload. A thinner spacer will increase preload.

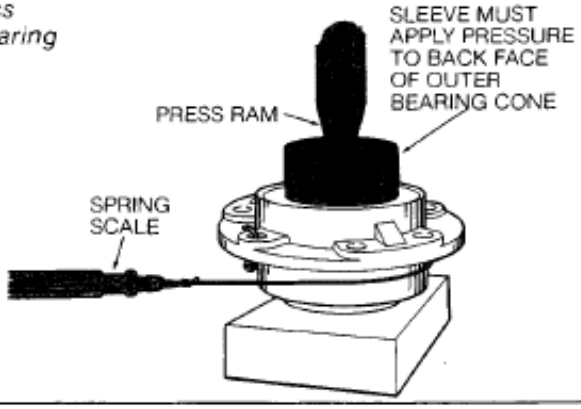
IMPORTANT: Once correct bearing preload has been established, note the spacer size used. Select a spacer 0.001" larger for use in the final pinion bearing cage assembly. The larger spacer compensates for slight "growth" in the bearings which occurs when they are pressed on the pinion shank. The trial build-up will result in proper pinion bearing preload in three of four cases.

IMPORTANT: Do not assume that all assemblies will retain proper preload once bearings are pressed on pinion shank. FINAL PRELOAD TEST MUST BE MADE IN EVERY CASE.

Assemble these Parts for Trial Build-up.



Cage in Press to Check Bearing Preload.



Specifications for Pinion Bearing Trial Build-up Preload Test ("Press-fit" Outer Pinion Bearings)					Spring Scale Reading (without pinion seal) (for 10-20 in-lbs. torque) (1.1-2.3 N·m)	
	Nominal Bearing Spacer Thickness		Press Loads			
	in.	mm	Tons	Metric Tons	lbs.	kgs.
ESD-18 Steer-Drive Axle Differential Carrier	0.638	16.2	13.5-15.5	12.2-14.0	4-8	2-4

Final Pinion Bearing Preload Test

1. Assemble the complete pinion bearing cage unit as recommended in the assembly section of this manual.

NOTE: Forward axle pinion is equipped with helical gear. For easier disassembly during bearing adjustment procedure, use a dummy yoke (if available) in place of helical gear.

2. Apply clamp load to the pinion bearing cage assembly. Either install the yoke (or helical gear) and torque the pinion nut to specifications or use a press to simulate nut torque (see chart below).

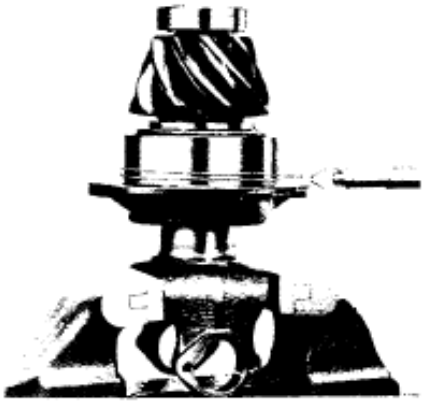
Vise Method — If the yoke and nut are used, mount the assembly in a vise, clamping yoke firmly.

Press Method — If a press is used, position a sleeve or spacer so that load is applied directly to the back-face of the outer bearing cone.

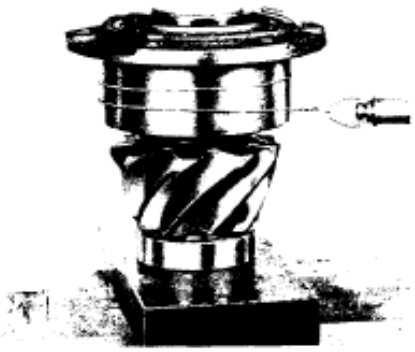
3. Measure Pinion Bearing Preload — Use a spring scale to test the assembly rolling torque. To use the spring scale, wrap soft wire around the bearing cage, attach the scale and pull. Preload is correct when torque required to rotate the pinion bearing cage is from 15 to 35 inch pounds. This specification is translated into spring scale readings in the chart below.

4. Adjust Pinion Bearing Preload — If necessary, adjust pinion bearing preload. Disassemble the pinion bearing cage as recommended in this manual and change the pinion bearing spacer. A thicker spacer will decrease preload. A thinner spacer will increase preload.

IMPORTANT: Use the correctly sized spacer. Do not use shim stock or grind spacers. These practices can lead to loss of bearing preload and gear or bearing failure.



Measuring Bearing Preload with Pinion in Vise.



Measuring Bearing Preload with Pinion in Press.

Specifications for Final Pinion Bearing Preload Test ("Press-fit" Outer Pinion Bearings)					Spring Scale Reading (without pinion seal) (for 15-35 in-lbs. torque) (1.7-4 N·m)	
	Nut Torque		Press Loads			
	Ft-lbs.	N·m	Tons	Metric Tons	lbs.	kgs.
ESD-18 Steer-Drive Axle Differential Carrier	560-700	759-949	13.5-15.5	12.2-14.0	6-14	3-6

Differential Bearing Preload and Ring Gear Backlash Adjustment

Correct differential bearing preload insures proper location of these bearings under load and helps position the ring gear for proper gear tooth contact.

(Follow procedures in numerical sequence.)

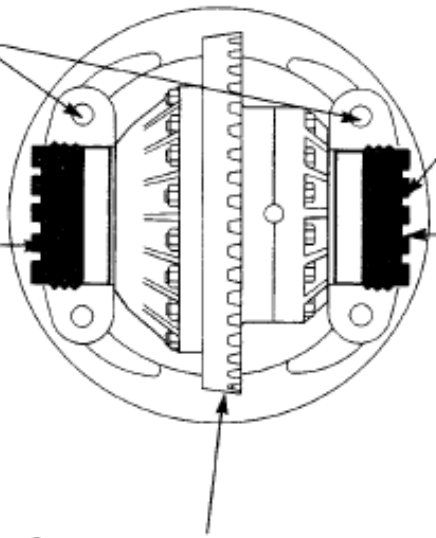
Adjust Diff. Bearing Preload

1. Lubricate differential bearings.

IMPORTANT: When installing bearing caps and adjuster, exert care not to cross threads.

2. Install adjusters and bearing caps. Tighten bearing cap screws finger-tight. If this is difficult, use a hand wrench.

NOTE: Single Reduction Gearing Illustrated.



3. Loosen the bearing adjuster on the same side as the ring gear teeth until its first thread is visible.

4. Tighten the bearing adjuster on the back-face side of the ring gear until there is no backlash.

This can be tested by facing the ring gear teeth and pushing the gear away from the body while gently rocking the gear from side to side. There should be no free movement.

Rotate the ring gear and check for any point where the gear may bind. If such a point exists, loosen and retighten the back side adjuster. Make all further adjustments from the point of tightest mesh.

5. At teeth side of ring gear, tighten adjuster until it contacts the bearing cup. Continue tightening adjuster two or three notches and this will preload bearings and provide backlash.

6. Measure backlash with a dial indicator.

USED GEARING — Reset to backlash recorded before disassembly.

NEW GEARING — Backlash should be between 0.006" and 0.016". If backlash is incorrect, proceed as described below to readjust.

Adjust Ring Gear Backlash

To **add** backlash: Loosen the adjuster on the teeth side of the ring gear several notches. Loosen the opposite adjuster one notch.

Return to adjuster on teeth side of the ring gear and tighten adjuster until it contacts the bearing cup. Continue tightening the same adjuster 2 or 3 notches. Recheck backlash.

To **remove** backlash: Loosen the adjuster on the teeth side of the ring gear several notches. Tighten the opposite adjuster one notch.

Return to adjuster on teeth side of ring gear and tighten adjuster until it contacts the bearing cup. Continue tightening the same adjuster 2 or 3 notches. Recheck backlash.

Moving adjuster one notch is the movement of the lead edge of one adjuster lug to the lead edge of the next lug past a preselected point.

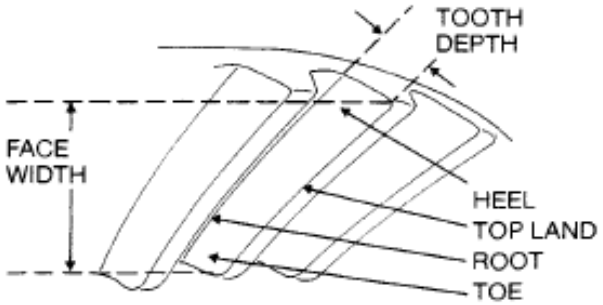
NOTE: Rear axle gearing is shown in the following instructions. Correct tooth contact patterns and adjustments are the same for forward and rear axles.

Ring Gear and Pinion Tooth Contact

Check Tooth Contact Pattern (NEW GEAR)

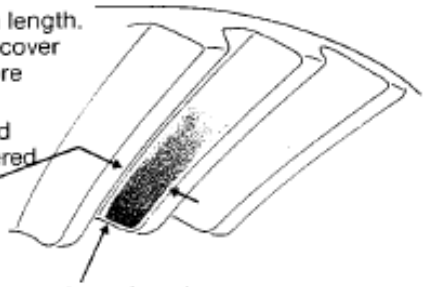
Paint twelve ring gear teeth with marking compound and roll the gear to obtain a contact pattern. The correct pattern is well-centered on the ring gear tooth with lengthwise contact clear of the toe. The length of the pattern in an unloaded condition is approximately one-half to two-thirds of the ring gear tooth in most models and ratios.

RING GEAR TOOTH NOMENCLATURE



CORRECT PATTERN (NEW GEARING)

- Could vary in length. Pattern should cover 1/2 tooth or more (face width).
- Pattern should be evenly centered between tooth top land and root.
- Pattern should be clear of tooth toe.



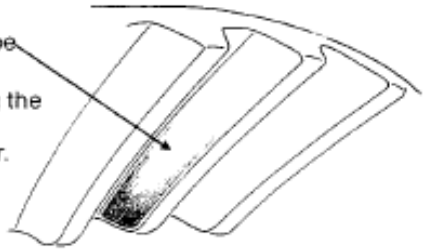
Check Tooth Contact Pattern (USED GEAR)

Used gearing will not usually display the square, even contact pattern found in new gear sets. The gear will normally have a "pocket" at the toe-end of the gear tooth which tails into a contact line along the root of tooth. The more use a gear has had, the more the line becomes the dominant characteristic of the pattern.

Adjust used gear sets to display the same contact pattern observed before disassembly. A correct pattern is clear of the toe and centers evenly along the face width between the top land and root. Otherwise, the length and shape of the pattern are highly variable and is considered acceptable as long as it does not run off the tooth at any point.

CORRECT PATTERN (USED GEARING)

- Pocket may be extended.
- Pattern along the face width could be longer.



Adjust Tooth Contact Pattern

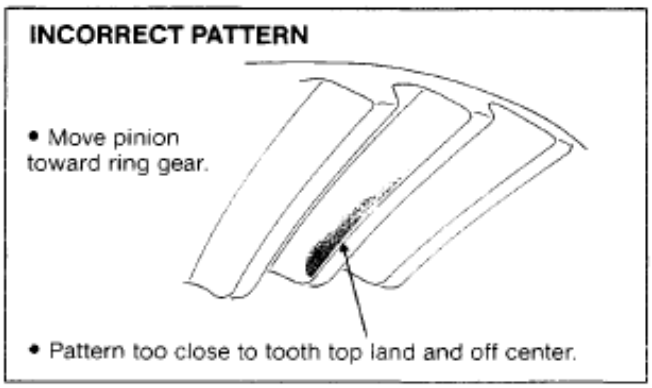
If necessary, adjust the contact pattern by moving the ring gear and drive pinion. Ring gear position controls the backlash. This adjustment moves the contact pattern along the face width of the gear tooth. Pinion position is determined by the size of the pinion bearing cage shim pack. It controls contact on the tooth depth of the gear tooth.

These adjustments are interrelated. As a result, they must be considered together even though the pattern is altered by two distinct operations. When making adjustments, first adjust the pinion, then the backlash. Continue this sequence until the pattern is satisfactory.

Adjust Pinion Position

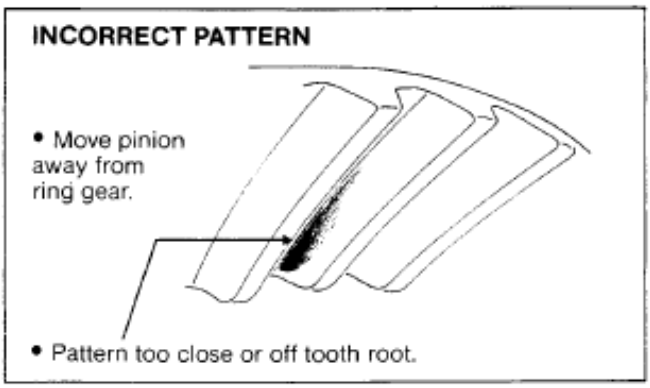
If the gear pattern shows incorrect tooth depth contact, change drive pinion position by altering the shim pack. Used gears should achieve proper contact with the same shims removed from the axle at disassembly.

INCORRECT PATTERN



If the pattern is too close to the top land of the gear tooth, remove pinion shims.

INCORRECT PATTERN



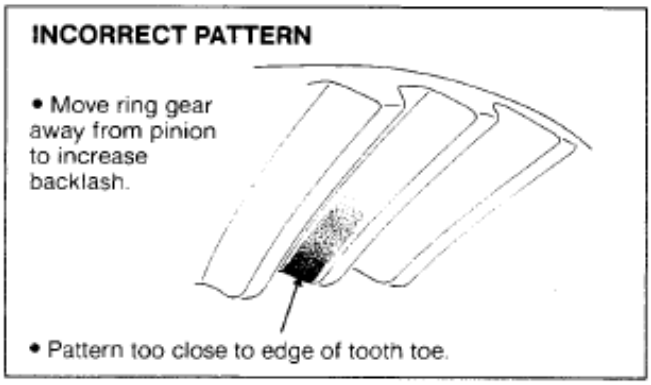
If the pattern is too close to the root of the gear tooth, add pinion shims.

NOTE: Check ring gear backlash after each shim change and adjust if necessary to maintain the 0.006" to 0.016" specifications.

Adjust Backlash

If the gear pattern shows incorrect face width contact, change backlash.

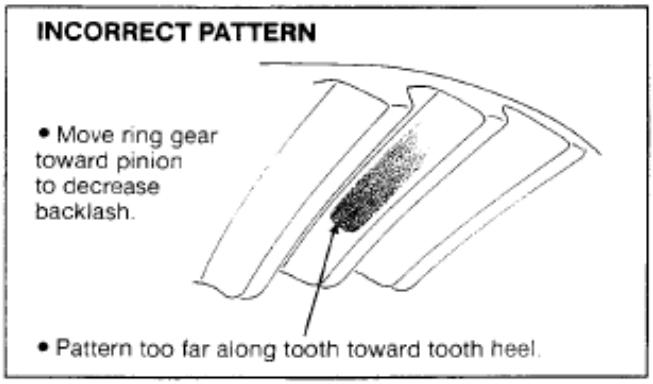
INCORRECT PATTERN



With the pattern concentrated at the toe (too far down the tooth), **add backlash** by loosening the bearing adjuster on the teeth side of ring gear several notches. Loosen the opposite adjuster one notch.

Return to adjuster on teeth side of ring gear and tighten adjuster until it contacts the bearing cup. Continue tightening the same adjuster 2 or 3 notches. Recheck backlash.

INCORRECT PATTERN



If the pattern is concentrated at the heel (too far up the tooth), **remove backlash** by loosening the bearing adjuster on the teeth side of ring gear several notches. Tighten the opposite adjuster one notch.

Return to adjuster on teeth side of ring gear and tighten adjuster until it contacts the bearing cup. Continue tightening the same adjuster 2 or 3 notches. Recheck backlash.

Remove Differential Carrier Assembly from Axle Housing

NOTE: To permit removal of the differential carrier assembly, the axle shafts must be disengaged from the differential side gears. This can be accomplished by removing the wheel end parts and the axle shaft. (Refer to Wheel End Overhaul Instructions.)

Or, if equipment is available, the axle shafts can be disengaged by separating the wheel end assembly from the axle housing (see illustration)

1. Drain axle lube.

2. To separate wheel end assembly from axle housing, remove cap screws and nuts fastening socket ball flange to the housing. Provide equipment to handle the wheel end assembly. Then disconnect air brake lines and steering connections as necessary to permit moving the wheel end assembly outwardly until the axle shaft is disengaged from the differential side gear. Disengage axle shaft on both sides of axle.

3. Dual Range Axles. Shift to Axle Low Range. Disconnect shift unit air line. Remove shift unit.

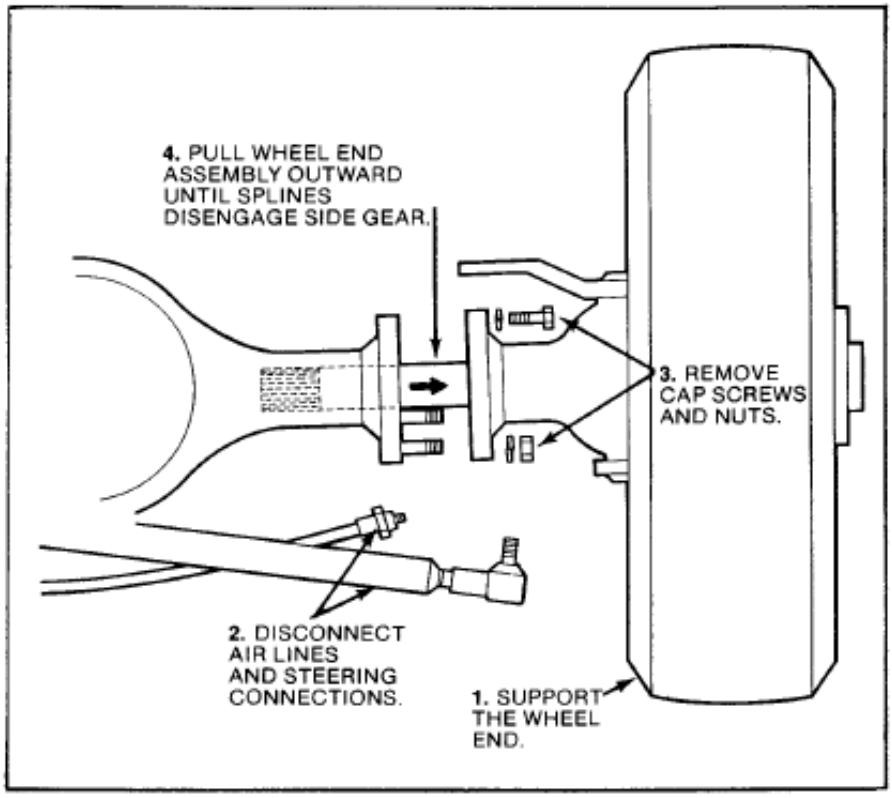
NOTE: When shift unit is removed, provide container to catch oil that escapes from reservoir.

4. Axles with Controlled Traction Differentials.

Driver-Controlled Engagement Type: Remove shift unit nuts and washers. Disconnect air line to permit removal of shift unit. Place sliding clutch in the engaged position. (Sliding clutch must be engaged to allow removal of carrier from housing.) Remove shift unit.

Seasonal Engagement Type: Remove nuts and washers from shift fork cover retainer, then remove cover retainer. Place sliding clutch in the engaged position. (Sliding clutch must be engaged to allow removal of carrier from housing.)

Permanent Engagement Type: Sliding clutch is always engaged. No procedure is necessary to remove differential carrier.


4. PULL WHEEL END ASSEMBLY OUTWARD UNTIL SPLINES DISENGAGE SIDE GEAR.
3. REMOVE CAP SCREWS AND NUTS.
2. DISCONNECT AIR LINES AND STEERING CONNECTIONS.
1. SUPPORT THE WHEEL END.

Separating (or removing) Wheel End Assembly to Disengage Axle Shaft Splines from Side Gear.

5. Disconnect drive shaft. Loosen but do not remove drive pinion nut.

6. Remove differential carrier assembly.

⚠ **WARNING:** DO NOT LIE UNDER CARRIER AFTER FASTENERS ARE REMOVED. USE TRANSMISSION JACK TO SUPPORT AND REMOVE DIFFERENTIAL CARRIER ASSEMBLY.

Remove nuts and washers fastening carrier to axle housing.

Remove differential carrier assembly.

Install Differential Carrier Assembly

IMPORTANT: Before installing carrier assembly, inspect and thoroughly clean interior of axle housing.

NOTE: Use silicone rubber gasket compound on axle housing mating surface as shown in the illustration. Compound will set in 20 minutes. Install carrier before compound sets or reapply.

Dual Range Axles: Shift axle to Low Range before installing differential carrier assembly.

Axles with Controlled Traction Differentials: Place sliding clutch in the engaged position before installing differential carrier assembly.

1. Install differential carrier assembly in axle housing. Install stud nuts and lockwashers. Tighten to correct torque (see chart).

2. Connect inter-axle drive line.

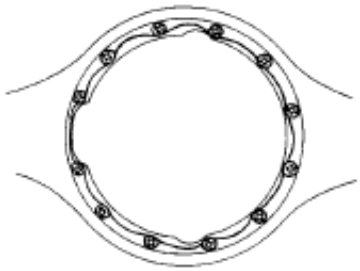
3. Dual Range Axle and Axles with Controlled Traction Differentials: Install shift unit, nuts and lockwashers. Torque nuts (see chart). Connect air line.

4. Install axle shafts if they were removed. Refer to Wheel End Overhaul Instructions.)

If wheel end assembly was removed, install the assembly and fasten socket ball to axle housing with nuts, cap screws and lockwashers. Torque nuts and cap screws (see chart). Connect air brake lines and steering connections.

5. Fill axle with correct lube (see Lubrication Section).

IMPORTANT: When axle has been disassembled or housing, gears, axle shafts or wheel equipment replaced, check axle assembly for proper differential action before operating vehicle. Wheels must rotate freely and independently.

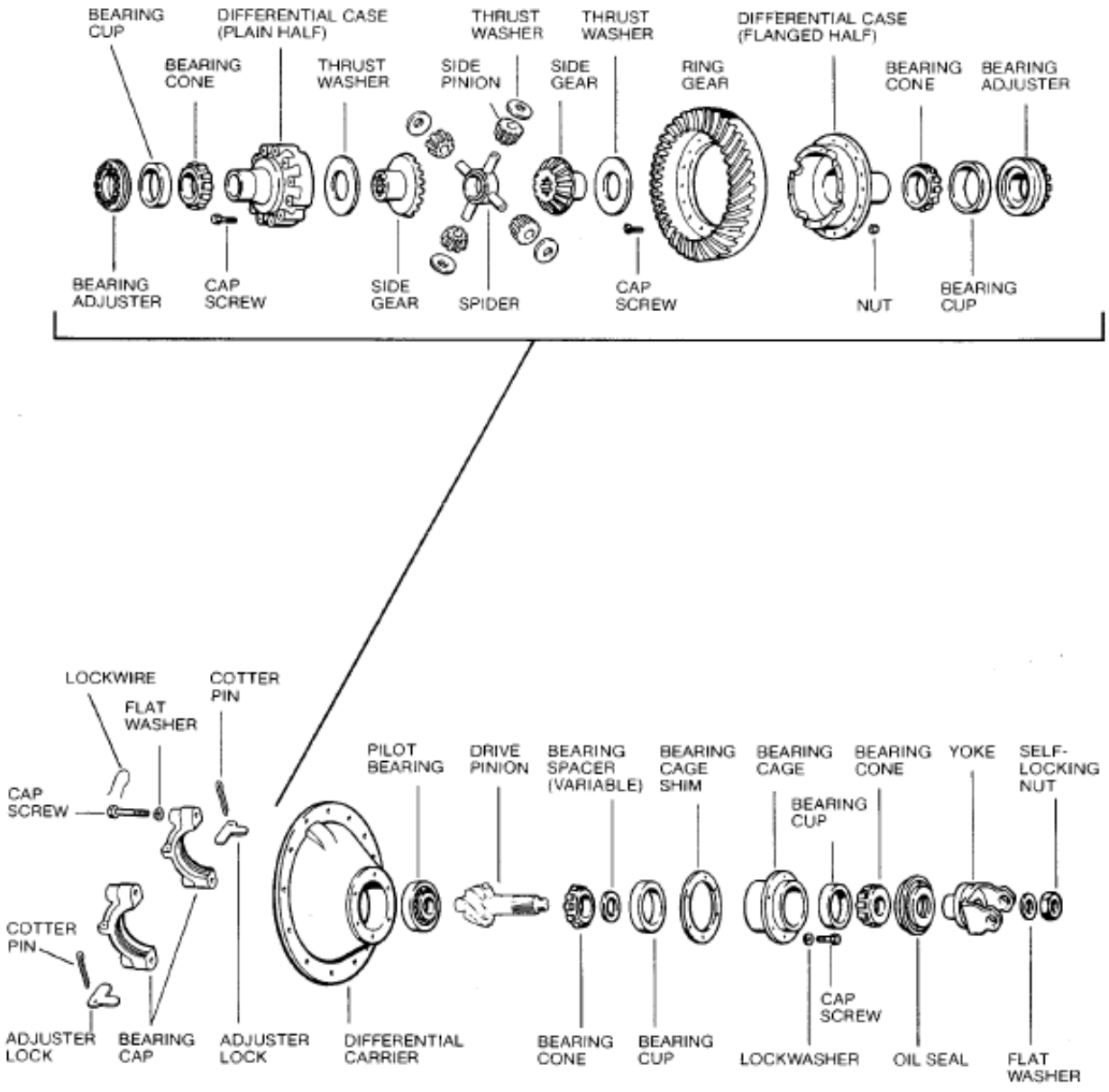


Axle Housing Silicone Gasket Compound Pattern.

Torque Chart

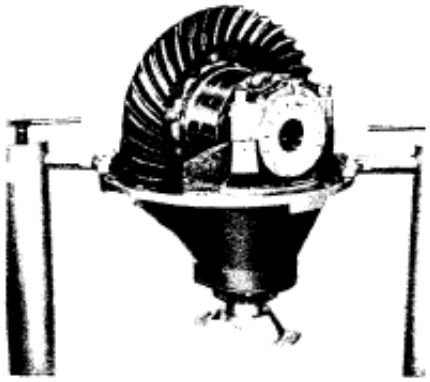
Differential Carrier		
Stud Nut	**Ft-lbs.**	**N·m**
5/8-18 Grade (8) Stud	220-240	298-325
Shift Unit		
Stud Nut	**Ft-lbs.**	**N·m**
7/16-20 Grade (8) Stud	55-61	74-82
Socket Ball to Housing		
Stud Nut	**Ft-lbs.**	**N·m**
3/4-16 Grade (8) Stud	280-360	380-488
Cap Screw		
5/8-11 Grade (8)	170-220	231-298

Differential Carrier Assembly Single Reduction

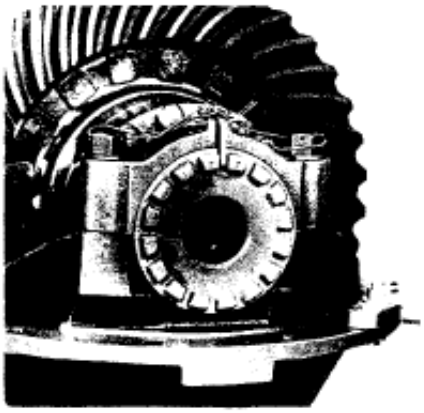


Disassemble Differential Carrier

NOTE: If gear set is to be reused, check tooth contact pattern and ring gear backlash before disassembling differential carrier. Best results are obtained when established wear patterns are maintained in used gearing. Omit this step if the gear set is to be replaced.

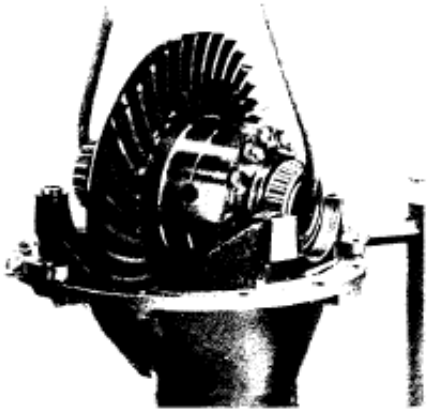


1. Mount Differential Carrier Assembly in repair stand. Loosen but do not remove pinion nut.



2. Punch mark differential bearing caps. If reusing gear set, also punch mark bearing adjusters for reference during assembly.

3. Cut lockwire. Remove cap screws, flat washers and bearing caps.



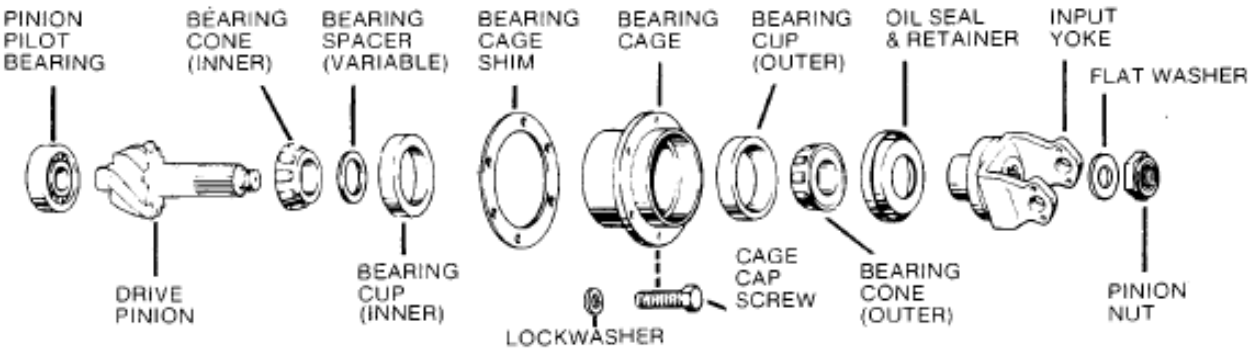
4. Using a chain hoist, lift ring gear and differential assembly out of carrier.

5. Remove pinion bearing cage cap screws, then drive pinion, cage and yoke assembly out of carrier.

IMPORTANT: Do not allow pinion to drop on hard surface. Remove shim pack.

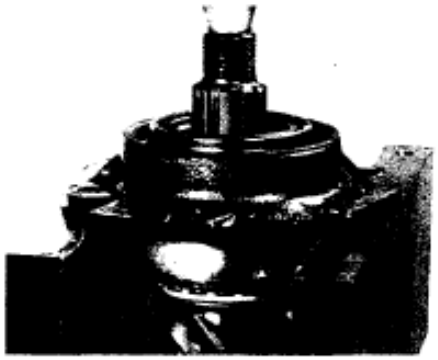
IMPORTANT: If gear set is to be reused, keep pinion bearing cage shim pack intact for use in reassembly. If the original shims cannot be reused, record the number and size of shims in the pack.

Disassemble Drive Pinion



IMPORTANT: During the following yoke removal procedure, the drive pinion may fall out of bearings and cage. Do not allow pinion to drop on hard surface.

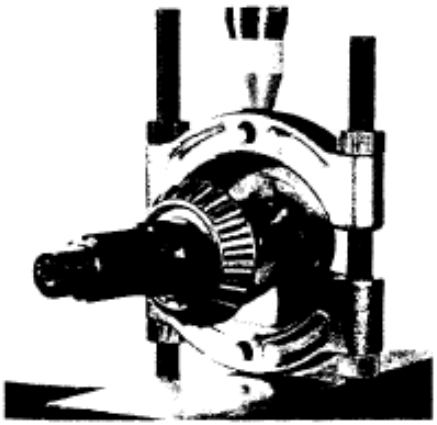
1. Remove yoke. If pinion nut was not loosened during earlier disassembly, clamp assembly in vise jaws, use brass pads to prevent damage. Loosen and remove pinion nut. Remove yoke from pinion.



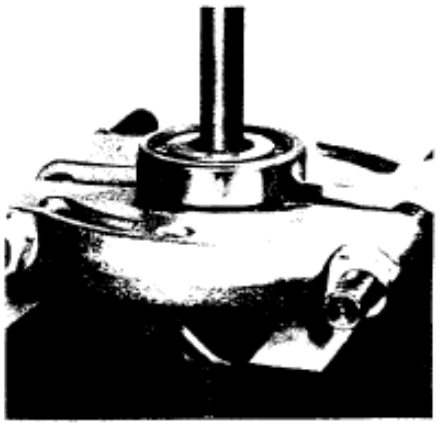
2. For pinion with "press-fit" bearing cone, support cage and press pinion out of bearing cage and bearing cone.

3. Remove oil seal and bearing cone from cage. Discard oil seal. Remove bearing cups with suitable puller.

4. Remove and retain bearing spacer from pinion.



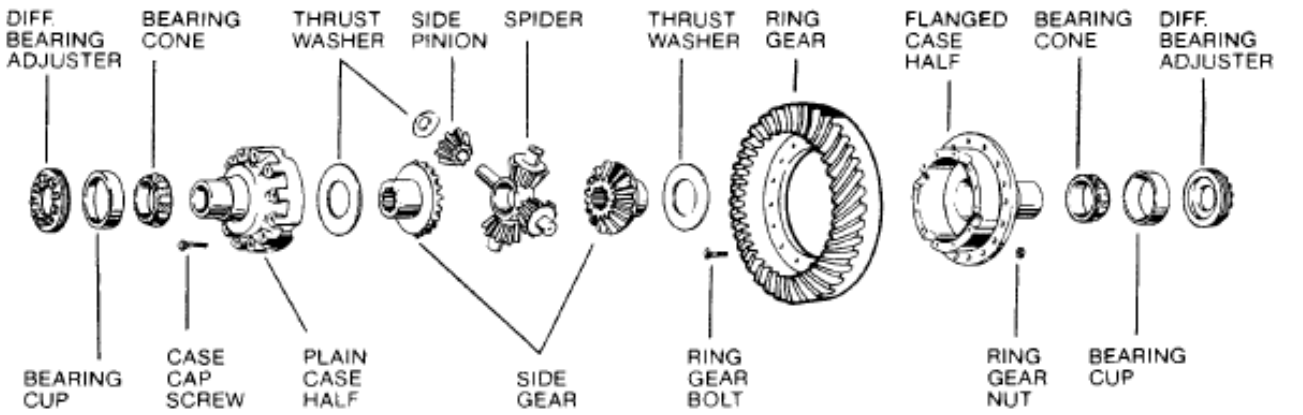
First. mount puller vertically to split bearing.



Second. mount puller horizontally to remove bearing.

5. Remove pilot bearing and inner bearing cone from pinion, using a split-type puller. Use two procedure steps to remove each bearing (see photos above).

Disassemble Wheel Differential



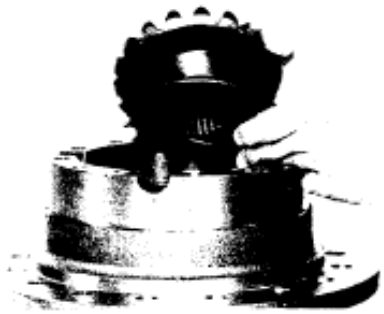
IMPORTANT: During following procedure, place differential assembly on malleable surface to prevent damage when ring gear falls off its mounting position.

1. Remove nuts and bolts fastening ring gear to differential cases, allowing gear to fall free. If gear does not fall, tap outer diameter with soft mallet to loosen.

2. Punch mark differential cases for correct location during assembly. Remove cap screws and lift off plain differential case half.

3. Lift out side gear and thrust washer.

4. Lift out spider, side pinions and thrust washers.

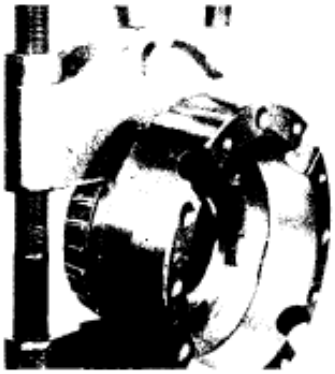


5. Remove side gear and thrust washer.

6. Remove bearing cones from case halves using suitable puller (see photos).

7. Remove bearing cone from plain case half in two steps: **First,** mount puller vertically to split bearing (see photo). This action will start moving bearing off case. **Second,** mount puller horizontally to remove cone.

8. Remove bearing cone from flanged case half using suitable puller.



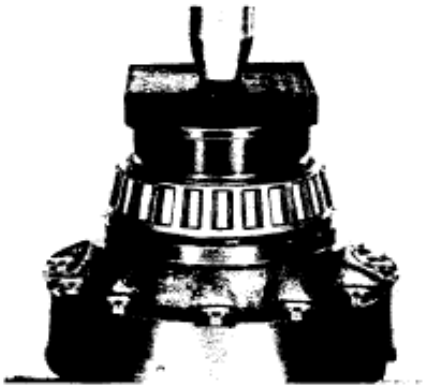
Puller Mounted Vertically to Split Bearing.

Removing Bearing Cone from Flanged Case Half.

Assemble Wheel Differential

NOTE: Lubricate differential parts with gear lube during assembly.

1. Press bearing cone on flanged differential case.



2. Press bearing cone on plain differential case.

3. Place thrust washer and side gear in flanged differential case.

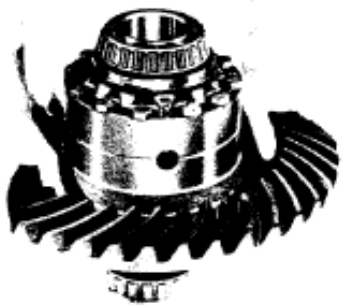
4. Assemble side pinion and thrust washers on spider. Place this assembly in flanged differential case. Rotate gears and check for proper mesh.

5. Place side gear and thrust washer on side pinions.

NOTE: Fasteners using self-locking nylon "patches" may be reused if not damaged, but should be secured by a few drops of Loctite #277 on threaded surface of differential case during following assembly procedures.

6. Align punch marks and install plain case half. Install cap screws and tighten to correct torque (see chart).

Check differential for free rotation by turning side gear hub. Differential may require up to 50 ft-lbs. (68 N·m) torque to rotate.



7. Install ring gear. Secure with bolts and nuts and tighten to correct torque (see chart).

Torque Chart

Ring Gear BOLT/NUT

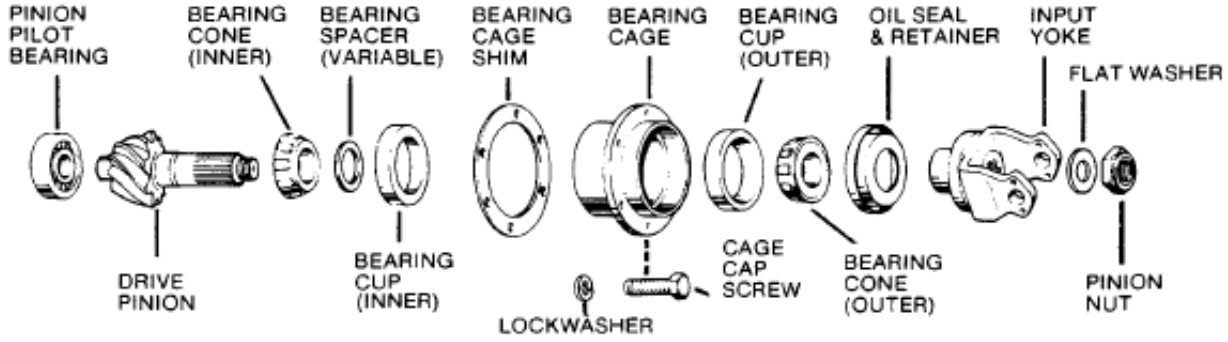
Size	Grade	Ft-lbs.	N·m
5/8-18	(8)	180-220	244-298

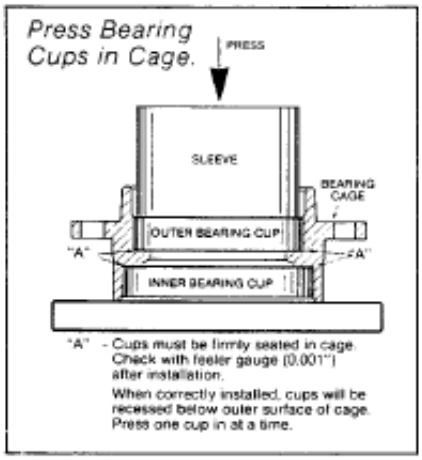
Differential Case CAP SCREW

Size	Grade	Ft-lbs.	N·m
9/16-12	(8)	150-180	203-244

Assemble Drive Pinion

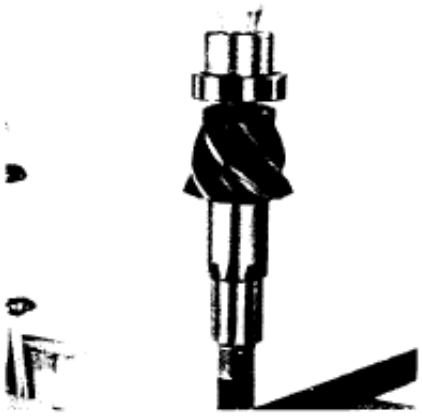
NOTE: Lubricate parts with gear lube during reassembly.



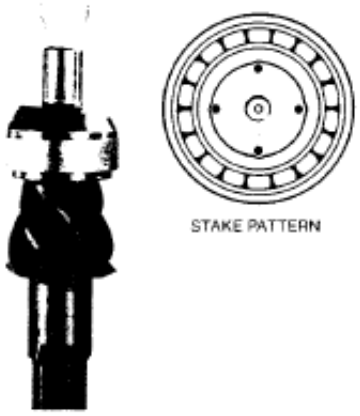

Press Bearing Cups in Cage.
PRESS
SLEEVE
BEARING CAGE
OUTER BEARING CUP
"A"
"A"
INNER BEARING CUP
"A" - Cups must be firmly seated in cage. Check with feeler gauge (0.001") after installation.
When correctly installed, cups will be recessed below outer surface of cage. Press one cup in at a time.

1. Press bearing cups in cage.

IMPORTANT: At this point, select pinion bearing spacer by using the "trial build-up" procedure described in the Adjustments Section of this manual.

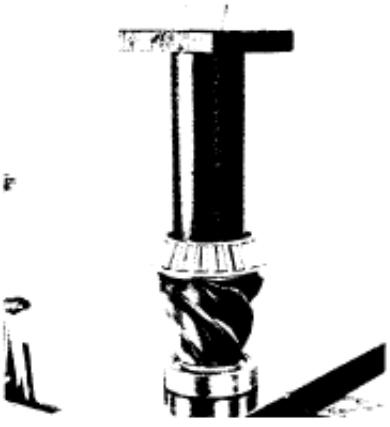


2. Press pilot bearing on pinion.



3. Stake pilot bearing using staking tool.

NOTE: During pinion bearing installation, locate each part in same position that was used in "Trial-Buildup" Preload Test.

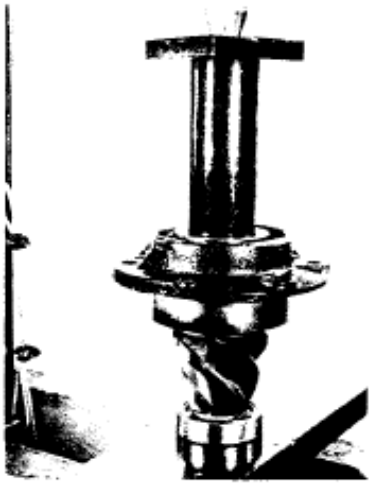


4. Press inner bearing cone on pinion.

5. Install bearing spacer (selected during "trial build-up" on pinion.

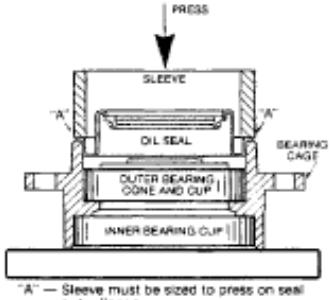
6. Install bearing cage on drive pinion.

Assemble Drive Pinion ("Press-fit" outer pinion bearing) *(Cont'd)*

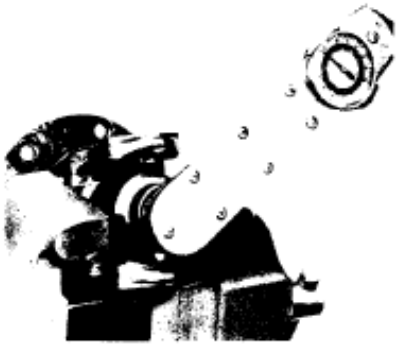


7. Press on outer pinion bearing cone.

Press Oil Seal in Cage.



8. Install oil seal with a press. Use properly sized sleeve to fit seal to prevent distortion during installation.



NOTE: Prior to installation of flange (or yoke), lubricate oil seal lip and make sure flange (or yoke) is clean and dry.

9. Install flange, flat washer and nut. Torque nut to 560-700 ft-lbs. (759-949 N·m).

IMPORTANT: At this stage of assembly, "final-check" pinion bearing preload. See Adjustment Section.

Install Drive Pinion

1. Place shim pack on carrier making sure lube hole is clear.

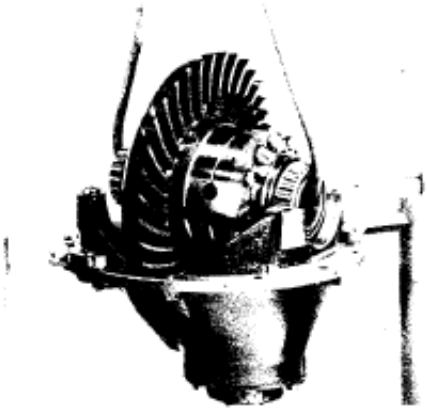
NOTE: If gear set is to be reused, install same quantity and size of shims removed during disassembly. When installing a new gear set, use nominal shim pack (0.023", 0.584"mm).

2. Install pinion assembly. Install bearing cage cap screws and lockwashers.

Torque cap screws to 100-125 ft-lbs. (136-170 N·m)

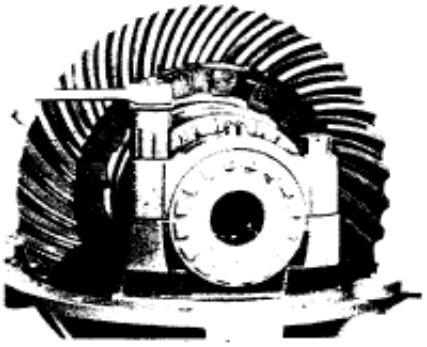
Install Differential and Ring Gear Assembly

NOTE: Lubricate bearings during the following assembly procedures.



1. Place ring gear and differential assembly in carrier. Carefully lower the assembly until bearing cones rest on carrier.

2. Install bearing cups at both sides of differential case. Install bearing adjusters and caps.



3. Install and tighten bearing cap screws finger-tight. If this is difficult, use hand wrench.

NOTE: The assembly is now ready for adjustment of differential bearing preload, ring gear backlash and gear tooth contact.

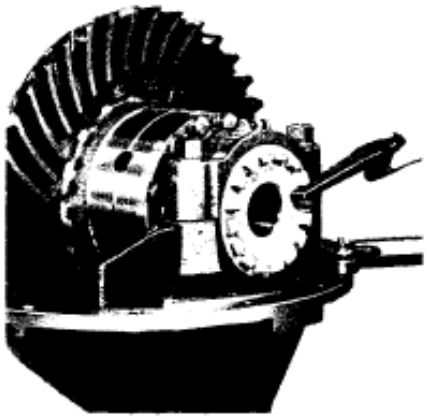
Adjust Differential Bearing Preload:

1. At the teeth-side of ring gear, position bearing adjuster until its first thread is visible.

2. At the back-face side of ring gear, tighten adjuster until there is no backlash.

3. At the teeth-side of ring gear, tighten adjuster until it contacts the bearing cup. Continue tightening adjuster two or three notches. This will preload bearings and provide backlash.

4. Check Ring Gear Backlash. Measure backlash with a dial indicator. Specifications are listed below. Refer to the Adjustment Section for detailed instructions on adjusting backlash.

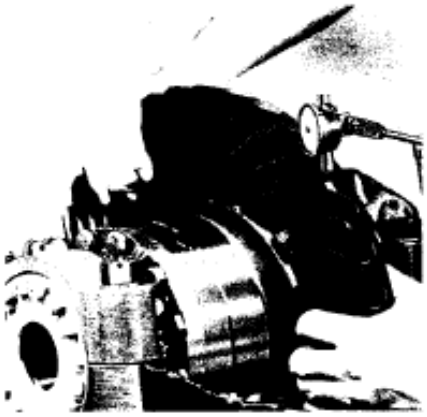


Adjusting Bearing Adjuster.

Ring Gear Backlash Specifications

USED GEARING — Reset to backlash recorded before disassembly.
NEW GEARING — Note: Check ring gear backlash after each shim change and adjust if necessary to maintain the .006" to .016" specifications.

5. Check Ring Gear Tooth Contact. Paint ring gear teeth and check tooth contact pattern. Correct tooth patterns are illustrated below. For checking and adjusting procedures, see Adjustment Section.



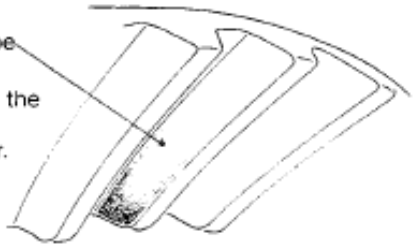
Checking Ring Gear Backlash.

6. With ring gear and pinion adjusted correctly, align adjusters and locks, then tighten differential bearing cap screws to correct torque 360-440 ft-lbs. (488-596 N·m).

Install adjuster locks and cotter pins. Lockwire differential bearing cap screws.

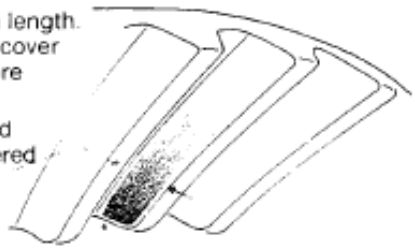
CORRECT PATTERN (USED GEARING)

- Pocket may be extended.
- Pattern along the face width could be longer.



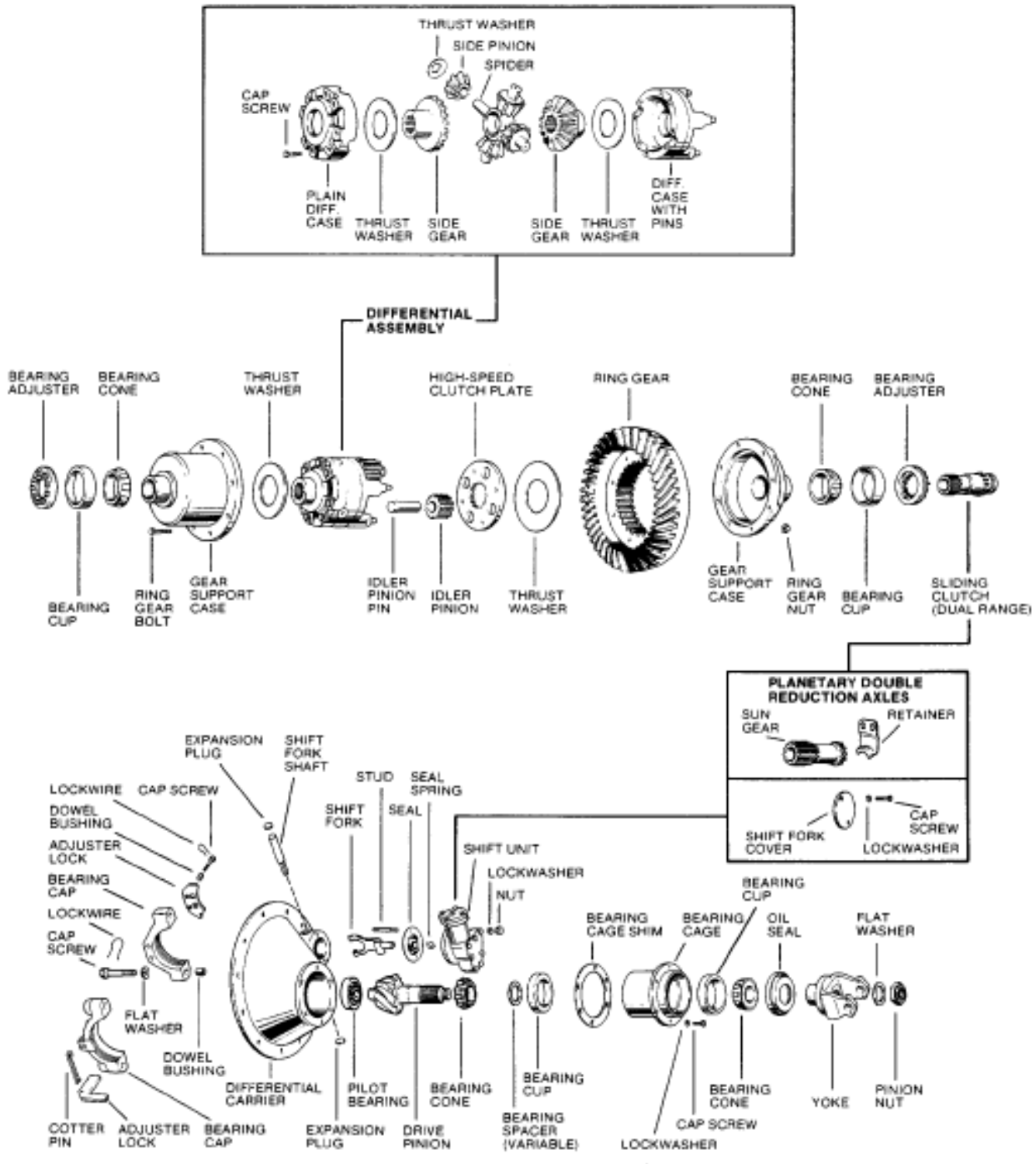
CORRECT PATTERN (NEW GEARING)

- Could vary in length. Pattern should cover 1/2 tooth or more (face width).
- Pattern should be evenly centered between tooth top land and root.



- Pattern should be clear of tooth toe.

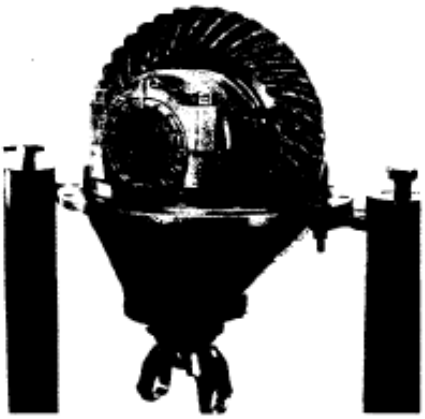
Differential Carrier Assembly Dual Range and Double Reduction



Disassemble Differential Carrier

NOTE: If the gear set is to be reused, check tooth contact pattern and ring gear backlash before beginning disassembly. Best overhaul results are obtained when used gearing is adjusted to run in established wear patterns. Omit this step if the gear set is to be replaced.

When reusing the gear set, remove the left-hand bearing cap, adjuster and lock as a unit. This will help return the gear set to its original adjustment during reassembly.



1. Mount the differential carrier in a repair stand .

2. Remove shift fork seal and spring. Remove expansion plugs, then working at the lower (or small) plug hole, drive out the shift fork shaft.

⚠ **WARNING:** WHEN USING A DRIFT, PUNCH OR SIMILAR TOOL, WEAR SAFETY GLASSES.

3. **2-Speed Axles Only:** Remove sliding clutch. **Planetary Double Reduction Axles:** A sun gear is used in place of sliding clutch gear. To remove sun gear, remove the retainer which holds gear in position, then remove sun gear.

NOTE: When reusing gearset, punch mark bearing adjusters and bearing caps for location and easier adjustment during reassembly.

4. On teeth-side of ring gear, cut lockwire and remove bearing cap screws. Remove cap, adjuster and lock.

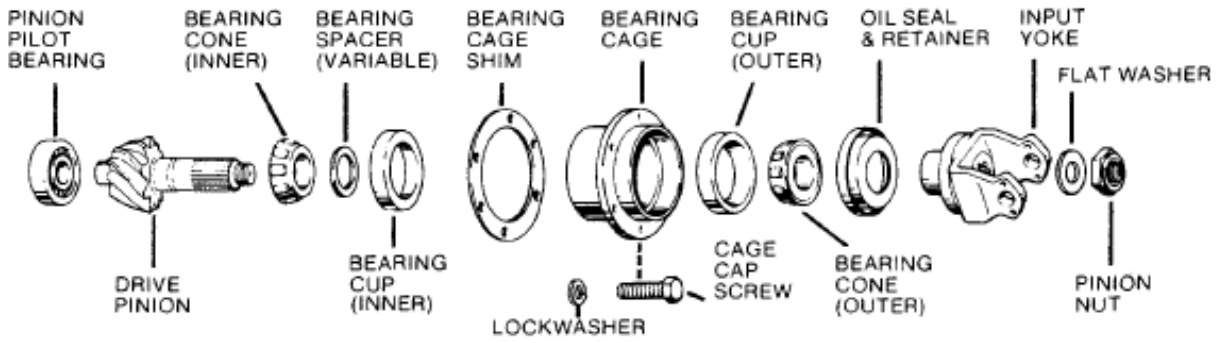
   On back-side of ring gear, cut lockwire and remove bearing cap screws. If the gear set is to be reused, remove bearing cap, adjuster and lock as an assembly. This will facilitate correct positioning of ring gear during reassembly.

5. Remove bearing cups, then lift ring gear and differential assembly out of carrier.

IMPORTANT: During removal of drive pinion assembly, do not allow pinion to drop on hard surface.

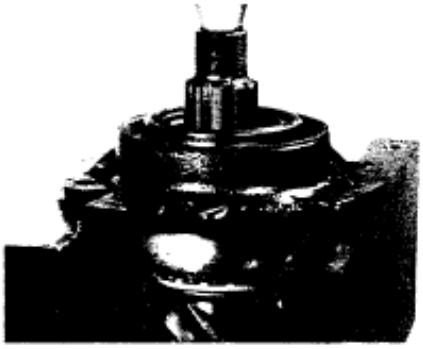
6. Remove pinion bearing cage cap screws, then drive pinion and cage assembly out of carrier. If the gear set is to be reused, keep the shim pack intact for use during reassembly. If the original shims cannot be reused, record the number of shims in the pack and the size of each.

Disassemble Drive Pinion



IMPORTANT: During the following yoke removal procedure, the drive pinion may fall out of bearings and cage. Do not allow pinion to drop on hard surface.

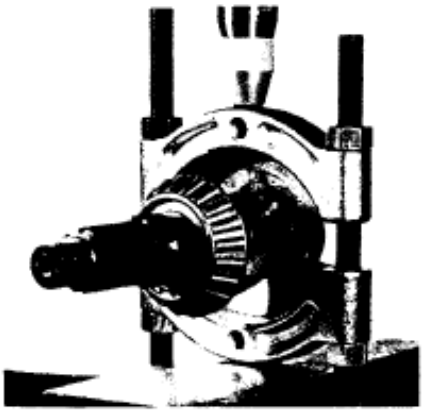
1. Remove yoke. If pinion nut was not loosened during earlier disassembly, clamp assembly in vise jaws, use brass pads to prevent damage. Loosen and remove pinion nut. Remove yoke from pinion.



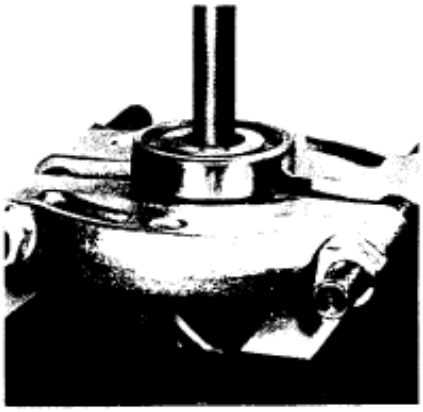
2. For pinion with "press-fit" bearing cone, support cage and press pinion out of bearing cage and bearing cone.

3. Remove oil seal and bearing cone from cage. Discard oil seal. Remove bearing cups with suitable puller.

4. Remove and retain bearing spacer from pinion.



First, mount puller vertically to split bearing.

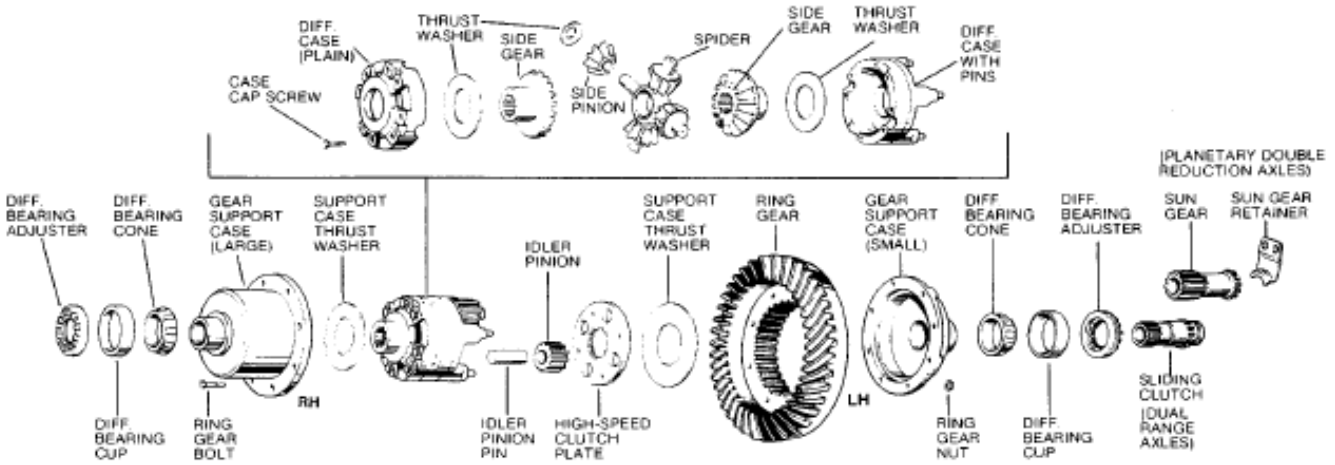


Second, mount puller horizontally to remove bearing.

5. Remove pilot bearing and inner bearing cone from pinion, using a split-type puller. Use two procedure steps to remove each bearing (see photos above).

Disassemble Wheel Differential

Rear Axle Wheel Differential Illustrated



1. Remove nuts and bolts fastening ring gear and support cases.

2. Remove small support case and thrust washer.

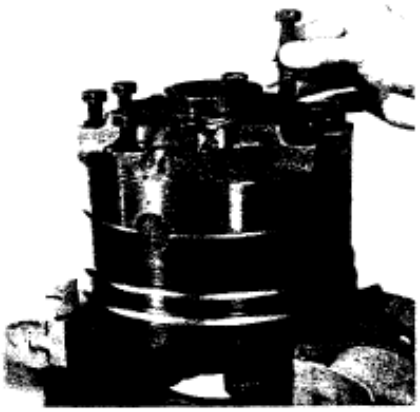
3. Remove ring gear.

NOTE: A soft-faced hammer or mallet may be required to dislodge gear from its mounting.

4. To remove differential assembly, place support case assembly on a bench or on the floor. Position case on its side, then slowly roll the case and slide differential assembly out of the case.

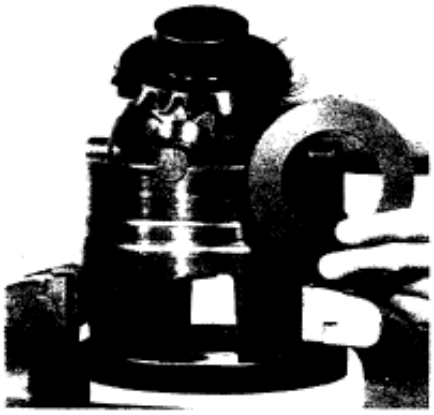
5. Remove thrust washer from support case.

6. Invert differential assembly to remove idler pins, then remove idler pinions.

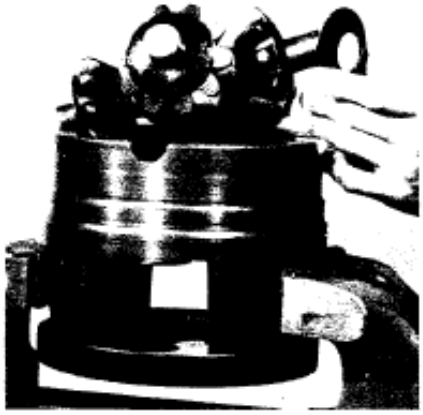


7. Punch mark differential cases for correct location in reassembly. Remove cap screws and separate case halves.

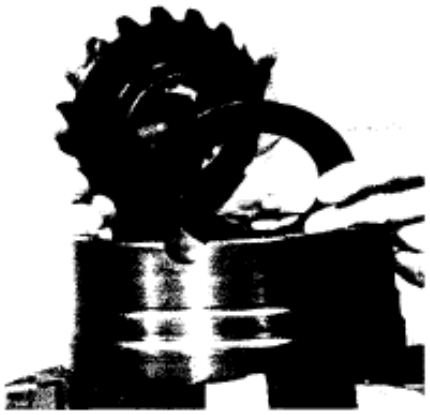
Disassemble Wheel Differential (Cont'd)



8. Lift out thrust washer and side gear.



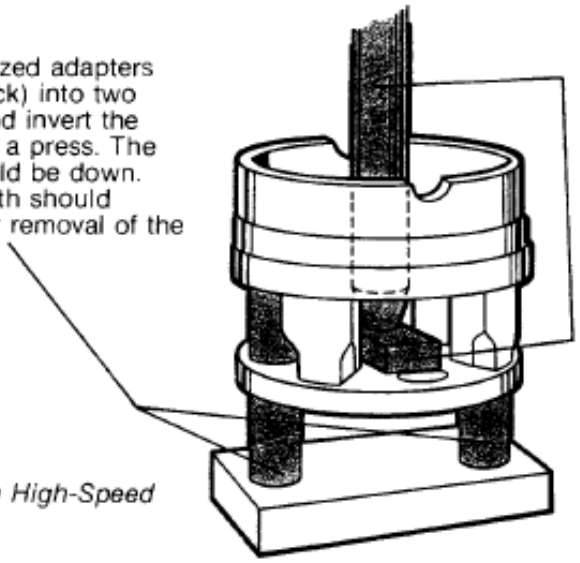
9. Lift out spider, side pinions and thrust washers.



10. Remove side gear and thrust washer.

11. First, try to lift off high-speed clutch plate by hand. If it cannot be removed easily, press off plate as follows:

a. Insert properly sized adapters (round metal stock) into two idler pin holes and invert the case assembly in a press. The clutch plate should be down. The adapter length should provide space for removal of the plate.



Setup for Removing High-Speed Clutch Plate

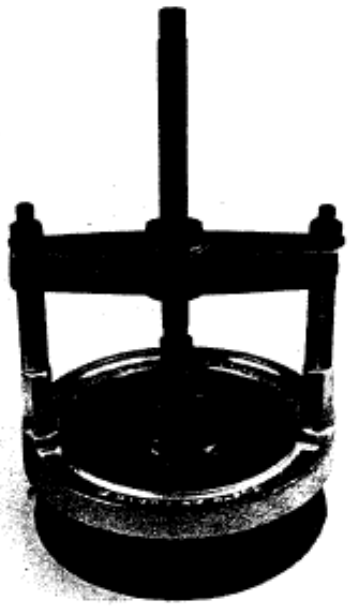
b. Use bar stock to block the center hole in the clutch plate and press against it with the press ram.

c. Continue to press until the plate breaks loose from the plate dowel pins.

12. Remove bearing cones from support cases using suitable puller (see photo).

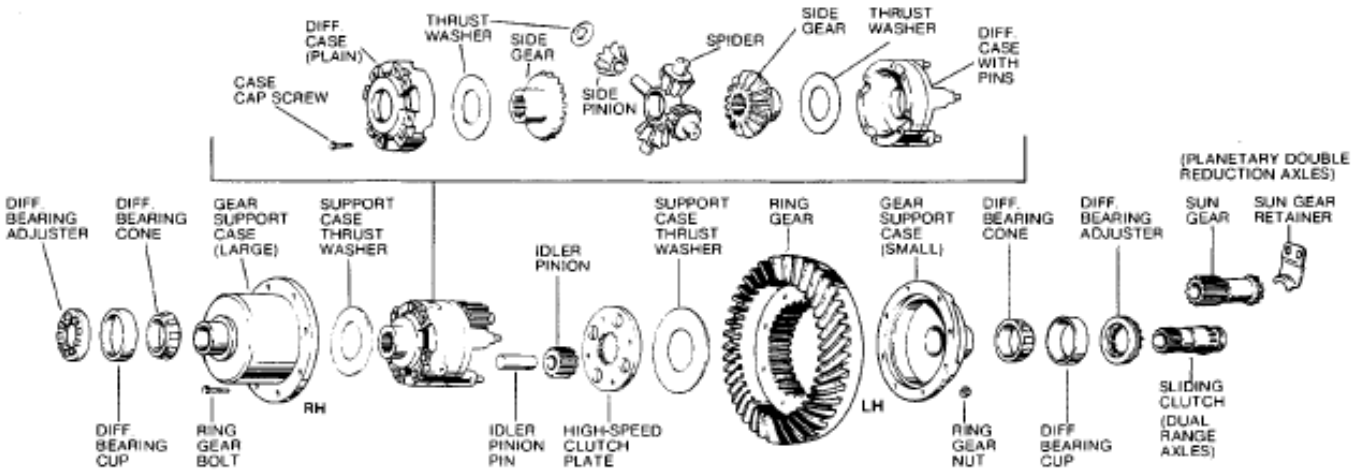
NOTE: Holes are provided in case to enable removal of bearing cone with a pin punch (see photo). Tap alternately through each hole until cone is removed.

WARNING: WHEN USING A DRIFT, PUNCH OR SIMILAR TOOL, WEAR SAFETY GLASSES.



Removing Bearing from Small Support Case using Puller.

Assemble Wheel Differential

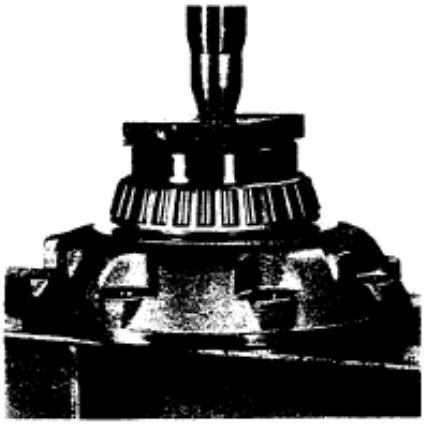


NOTE: Lubricate internal parts with gear lube during reassembly.

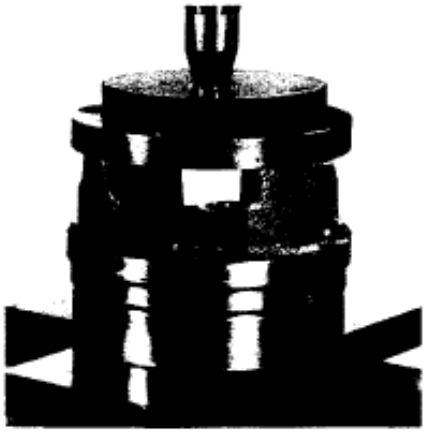
1. Press bearing cones on support cases (see photos).

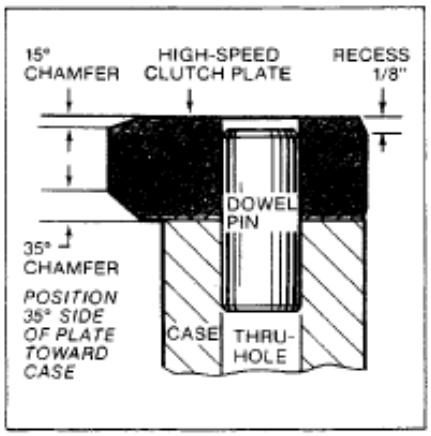
IMPORTANT: To prevent bearing cone damage, use suitable sleeve that only contacts the inner race of the cone.

Pressing Bearing Cone cn Large Support Case



Pressing Bearing Cone on Small Support Case





2. Position high-speed clutch plate with chamfered end of clutch teeth toward idler pinions. Press clutch plate on case.

IMPORTANT: It is important that the ends of the dowel pins are recessed 1/8" below surface of the clutch plate. If pins extend beyond plate surface, press pins to proper depth. Don't press them in too far.

3. Place thrust washer and side gear in differential case.

Assemble Wheel Differential (Cont'd)

4. Assemble side pinions and thrust washers on spider. Place this assembly in differential case.

5. Place side gear and thrust washer in position on side pinions.

6. Align punch marks and place plain case on case (with pins). Install cap screws and torque to 90-110 ft-lbs. (122-149 N·m).

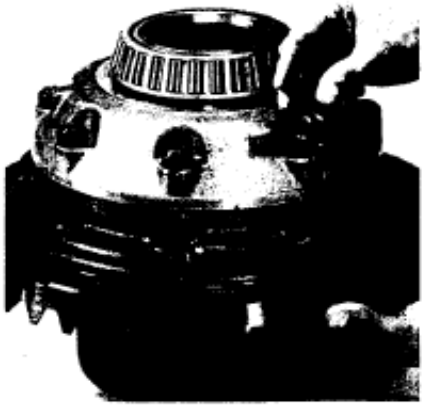
NOTE: Turn side gear hub to check for free differential rotation. Rotation may require up to 50 ft-lbs. (65 N·m).

7. Install idler pins and pinions.

8. Place thrust washer in support case.

9. During installation of ring gear, temporarily use two bolts in mounting holes to assure bolt hole alignment. Place ring gear on support case (see photo), then remove the two bolts.

11. Install thrust washer and small support case over differential assembly.



10. To install differential assembly, place support case and ring gear assembly on a bench or the floor. Position case on its side. Carefully lift and slide differential assembly into case. Engage idler pinions with ring gear teeth to complete the installation.

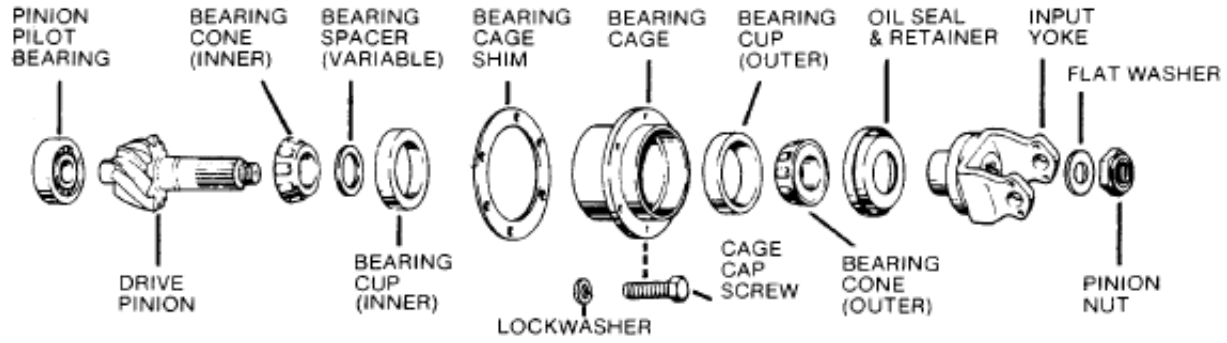
NOTE: During differential installation, be sure thrust washer stays in its proper mounting position.

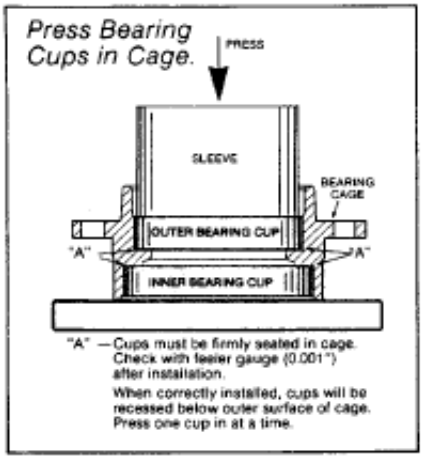
12. Carefully install ring gear bolts, making certain flat on bolt head is seated against the outside diameter of the support case. Install nuts and torque to 150-170 ft-lbs. (203-230 N·m)

NOTE: Temporarily install sliding clutch (or sun gear) and check planetary for free rotation.

Assemble Drive Pinion

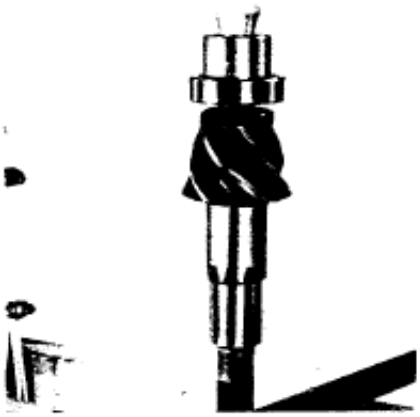
NOTE: Lubricate parts with gear lube during reassembly.



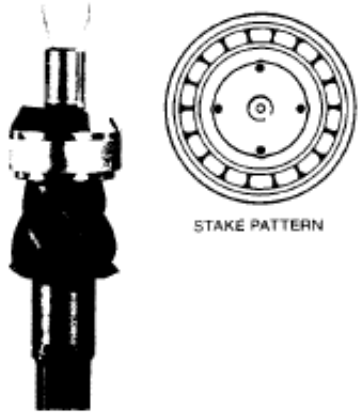

Press Bearing Cups in Cage.
PRESS
SLEEVE
BEARING CAGE
OUTER BEARING CUP
"A"
"A"
INNER BEARING CUP
"A" — Cups must be firmly seated in cage. Check with feeler gauge (0.001") after installation.
When correctly installed, cups will be recessed below outer surface of cage. Press one cup in at a time.

1. Press bearing cups in cage.

IMPORTANT: At this point, select pinion bearing spacer by using the "trial build-up" procedure described in the Adjustments Section of this manual.

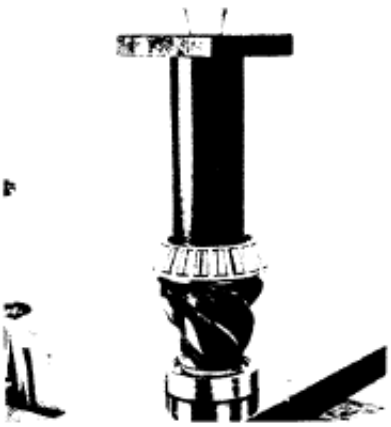


2. Press pilot bearing on pinion.



3. Stake pilot bearing using staking tool.

NOTE: During pinion bearing installation, locate each part in same position that was used in "Trial-Buildup" Preload Test.

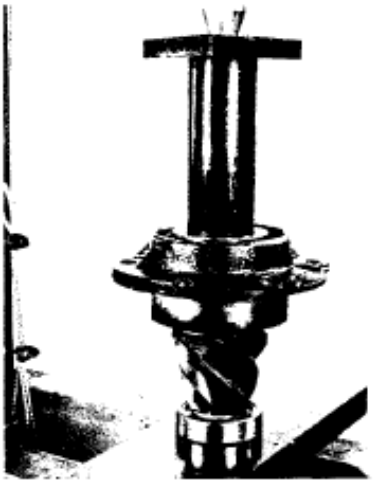


4. Press inner bearing cone on pinion.

5. Install bearing spacer (selected during "trial build-up") on pinion.

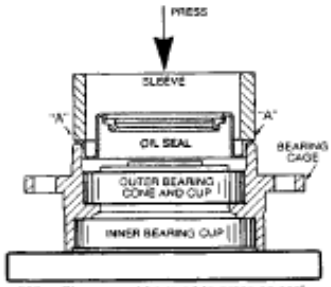
6. Install bearing cage on drive pinion.

Assemble Drive Pinion ("Press-fit" outer pinion bearing) (Cont'd)



7. Press on outer pinion bearing cone.

Press Oil Seal in Cage.



8. Install oil seal with a press. Use properly sized sleeve to fit seal to prevent distortion during installation.

NOTE: Prior to installation of flange (or yoke), lubricate oil seal lip and make sure flange (or yoke) is clean and dry.

9. Install flange, flat washer and nut. Tighten nut to correct torque 560-700 ft-lbs. (759-949 N·m).

IMPORTANT: At this stage of assembly, "final-check" pinion bearing preload. See Adjustment Section of this manual.

Install Pinion

1. Place shim pack on carrier making sure lube hole is clear (see photo).

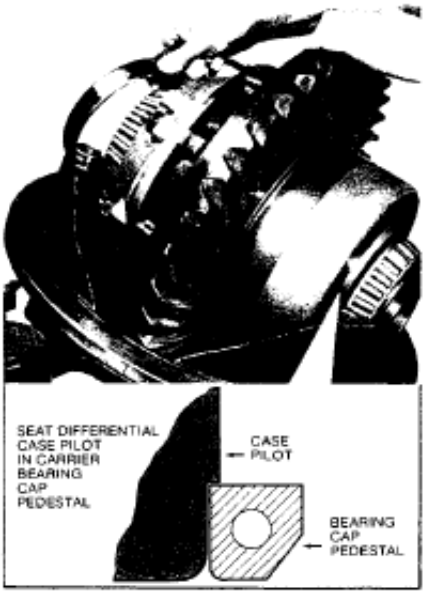
NOTE: If the gear set is to be re-used, use same quantity and size shims removed during disassembly. If a new gear set is to be installed, install a nominal shim pack (see chart).

Nominal Shim Pack	
in	mm
0.023	0.584

2. Install drive pinion assembly.

NOTE: Make certain lube holes in carrier, shims and cage are aligned. Install bearing cage cap screws and lockwashers. Torque cap screws to 100-125 ft-lbs. (136-170 N·m).

Install Differential in Carrier



NOTE: Lubricate bearings during the following assembly procedure:

1. Place ring gear and differential assembly in carrier. Insure that ring gear and drive pinion mesh properly.

During installation, tilt carrier to allow support case pilot to rest in carrier bore, then install bearing cup as shown in photo. Also install bearing cup on opposite side of differential.

2. If the same gear set is used, install the assembled bearing cap, adjuster and lock on the backface side of the ring gear. Otherwise install adjuster and cap separately.

NOTE: When installing cap, it may be necessary to tap it lightly with a hammer. Be sure cap is fully seated and threads are aligned properly. If trouble is encountered, check for cross-threading of bearing adjuster and carrier threads.

On teeth side of ring gear, install the other adjuster and bearing cap, observing same precautions to avoid cross-threading.

3. Install and tighten bearing cap screws *finger-tight*. If this is difficult, use hand wrench.

NOTE: The assembly is now ready for adjustment of differential bearing preload, ring gear backlash and gear tooth contact.

Adjust Differential Bearing Preload:

1. At the teeth-side of ring gear, position bearing adjuster until its first thread is visible.

2. At the back-face side of ring gear, tighten adjuster until there is no backlash.

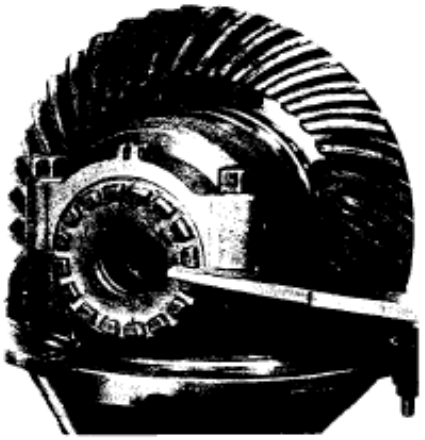
3. At the teeth-side of ring gear, tighten adjuster until it contacts the bearing cup. Continue tightening adjuster two or three notches. This will preload bearings and provide backlash.

4. Check Ring Gear Backlash. Measure backlash with a dial indicator. Specifications are listed below. Refer to Adjustment Section for detailed instructions on adjusting backlash.

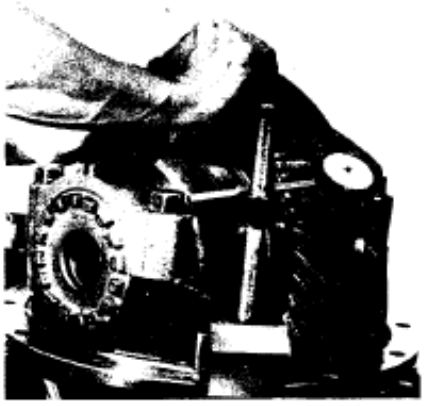
Ring Gear Backlash Specifications

USED GEARING — Reset to backlash recorded before disassembly.
NEW GEARING — Backlash should be between 0.006" and 0.016".

5. Check Ring Gear Tooth Contact. Paint ring gear teeth and check tooth contact pattern. Correct tooth patterns are illustrated below. For checking and adjusting procedures, see Adjustment Section.

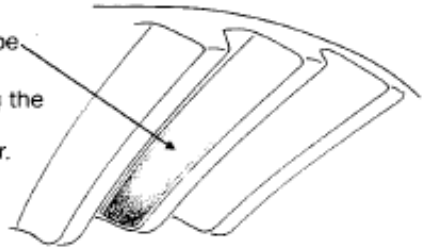


Adjusting Bearing Adjuster.

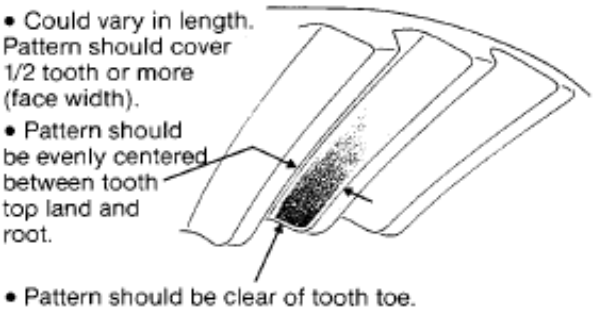


Checking Ring Gear Backlash.

CORRECT PATTERN (USED GEARING)



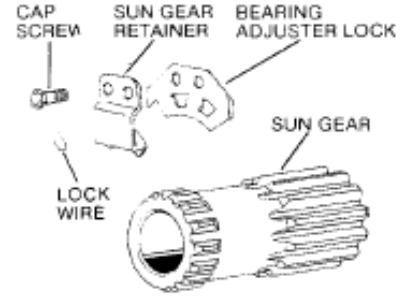
CORRECT PATTERN (NEW GEARING)


• Could vary in length. Pattern should cover 1/2 tooth or more (face width).
• Pattern should be evenly centered between tooth top land and root.
• Pattern should be clear of tooth toe.

6. With ring gear and pinion adjusted correctly, align adjusters and locks, then tighten differential bearing cap screws to correct torque (see chart next page). Install cotter pin in one adjuster lock. Install cap screws in opposite adjuster lock and tighten to correct torque (see chart next page). Lockwire bearing and adjuster lock cap screws.

Adjust Differential Bearing Preload (Cont'd)

7. For planetary double reduction axles (on backface side of ring gear), install sun gear and retainer, then install cap screws that fasten both retainer and adjuster lock cap screws. Tighten screws to correct torque (see chart), and lockwire all cap screws.

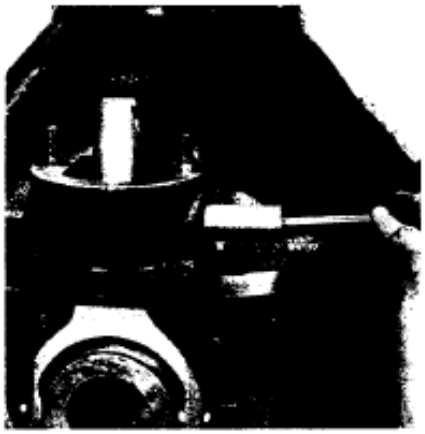


Planetary Double Reduction Axle

8. For dual range axles: Position shift fork in carrier opening, then install sliding clutch.

9. With clutch installed, engage shift fork yoke with clutch collar. Then install shift fork shaft. Install expansion plugs to seal openings.

10. Install shift unit seal and spring.



Installing Shift Fork Shaft.

Torque Chart

Differential Bearing Cap Cap Screw			
Size	**Grade**	**Ft.-lbs.**	**N·m**
13/16-10	(8)	370-430	501-583
Bearing Adjuster Lock and Sun Gear Retainer Cap Screw			
Size	**Grade**	**Ft.-lbs.**	**N·m**
5/8-11	(5)	160-176	217-239

These instructions cover the differential carrier and power divider assembly for the 4x4 rear axle. Contents are divided into major sections as indicated below.

Contents — **Section 3, Page No.**

4x4 REAR AXLE

Lubrication 2
Cleaning, Inspection, Repair 5
Adjustments 7
Differential Carrier Replacement 15

POWER DIVIDER OVERHAUL ..... **Section 4**

DIFFERENTIAL CARRIER OVERHAUL
Single Reduction ..... **Section 5**

DIFFERENTIAL CARRIER OVERHAUL
Dual Range and Double Reduction ..... **Section 6**

4x4 REAR AXLES

Single Reduction	185S4, 220S4, 230S4, 260S4, 300S4, 350S4
Dual Range	185T4, 220T4, 230T4, 260T4, 300T4, 350T4
Double Reduction	185P4, 220P4, 230P4, 260P4, 300P4, 350P4

Lubrication

The ability of a drive axle to deliver quiet, trouble-free operation over a period of years is largely dependent upon the use of good quality gear lubricant in correct quantity. The most satisfactory results can be obtained by following the directions contained in this book.

Approved Lubricants

Multigrade gear lubricants which meet the requirements of military specification MIL-L-2105-C are recommended for use in Spicer drive axles. These lubricants perform well over broad temperature ranges, providing good gear and bearing protection in a variety of climates. The MIL-L-2105-C specification divides lubricants into three major categories on the basis of lube viscosity at various temperatures. These are 75W, 80W-90 and 85W-140. 80W-140 lubricants are also available, but are listed with 80W-90 by MIL-L-2105-C. Lubricants approved under MIL-L-2105-B are also acceptable for use in Spicer Axles.

Synthetic Lubricants: Use of synthetic lubricants in Spicer Axles is approved only after Engineering Department review. This is essential to ensure proper seal life and axle performance with a particular synthetic. For additional information, contact Spicer Field Service Department, or call Regional Office. See back cover for address and phone numbers.

Oil Additives: The use of oil additives is *not* approved for use in Spicer axles.

Choosing the Correct Gear Lube

Axle gear lube should be selected on the basis of the ambient temperature range in which the vehicle normally operates. This should also be considered whenever changes in vehicle location or primary operating area are made, and the grade of lube changed if necessary.

Ambient Temperature Range	Proper Grade
-40° F to -15° F (-40° C to -26° C)	75W
-15° F to 100° F (-26° C to 38° C)	80W-90
-15° F and above (-26° C and above)	80W-140
10° F and above (-12° C and above)	85W-140

Lube Change Intervals

Initial Change: The lube in a new or rebuilt axle should be changed within the first 5000 miles of operation. This will remove fine particles of wear material generated during break-in and prevent accelerated wear on gears and bearings.

Subsequent Changes: Subsequent lube changes should be made at 100,000-mile intervals for Class "A" or "AA" highway operation.

Class "A" operation is defined as well-maintained highways of concrete or asphalt construction. Terrain level to rolling with maximum 8% grades. Class "AA" is turnpike. For other type operations, change lube at 40,000-mile intervals.

If the vehicle does not accrue enough mileage to require a lube change, change the lubricant once yearly.

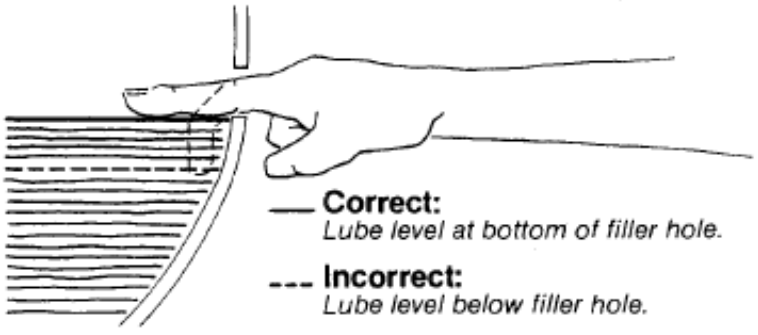
Adding Lube: If the lube level falls below its proper level between changes, it should be replenished as needed. Lubricants approved under the MIL-L-2105-C specification are compatible with each other and brands may be mixed. To maintain proper viscosity levels, however, do not mix lube grades when adding to an existing supply.

Checking Lube Level

Remove the filler hole plug located in the axle housing cover. Lube should be level with the bottom of this hole.

IMPORTANT: Lube level close enough to the hole to be seen or touched is not sufficient. It must be level with the hole.

NOTE: When checking lube level, also check and clean housing breathers.



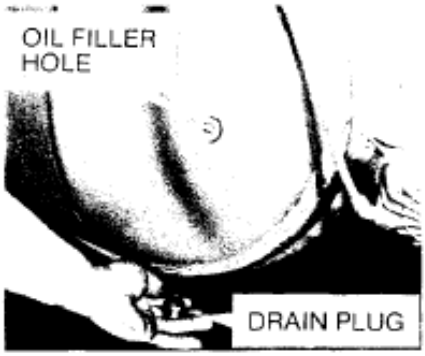
Changing Lube

Draining

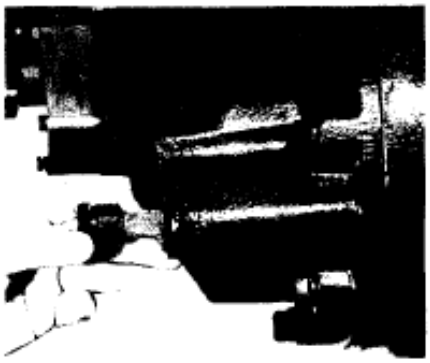
Drain when the lube is at normal operating temperature. It will run freely and minimize the time necessary to fully drain the axle.

Unscrew the magnetic drain plug on the underside of the axle housing and allow the lube to drain into a suitable container. Inspect drain plug for large quantities of metal particles. After initial oil change, these are signs of damage or extreme wear in the axle, and inspection of the entire unit may be warranted. Clean the drain plug and replace it after the lube has drained completely.

Axles with Lube Pump: Remove the magnetic strainer from the power divider cover and inspect for wear material in the same manner as the drain plug. Wash the magnetic strainer in solvent and blow dry with compressed air to remove oil and metal particles.



CAUTION: EXERCISE CARE TO DIRECT COMPRESSED AIR INTO SAFE AREA. WEAR SAFETY GLASSES.



Magnetic Strainer for Axles with Lube Pump.

Filling

Remove the filler hole plug from the center of the axle housing cover and fill the axle with approved lubricant until level with the bottom of the hole.

Forward Axles: Add four pints (1.88 liters) of lubricant through filler hole at the top of the differential carrier near the power divider cover.

Oil Filler Hole at top of Differential Carrier.

NOTE: Lube fill capacities in the adjacent chart are good guidelines but will vary somewhat on the basis of the angle the axle is installed in a particular chassis.

Always use the filler hole as the final reference. If lube is level with the bottom of the hole, the axle is properly filled.

Axles installed at angles exceeding 10 degrees or operated in areas of continuous and lengthy grades may require standpipes to allow proper fill levels.

Contact Spicer Field Service Department, or call Regional Office for specific recommendations. See back cover for address and phone numbers.

Lube Capacities
DO NOT OVERFILL AXLES

Axle Model	Lube Capacity* Pints (liters)
4x4 Rear Axle Series	
185, 220	39 (18)
230, 260	44 (21)
300, 350	41 (19)

*Add an additional 4 pints (1.88 liters) axle lubricant through filler hole at the top of the differential carrier near the power divider cover. (See photo above.)

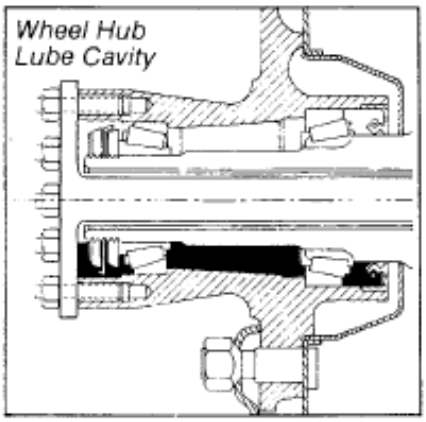
Capacities listed are approximate. The amount of lubricant will vary with angleof axle as installed in vehicle chassis. Figures do not apply to housings not designed or manufactured by Spicer.

Wheel Bearing Lubrication

Under normal operating conditions, axle wheel bearings are protected by lubricant carried into the wheel ends by the motion of axle shafts and gearing. Lube becomes trapped in the cavities of the wheel end and remains there, insuring that lube is instantly available when the vehicle is in motion.

IMPORTANT: In cases where wheel equipment is being installed, either new or after maintenance activity, these cavities are empty. Bearings must be manually supplied with adequate lubricant or they will be severely damaged before the normal motion of gearing and axle shafts can force lube to the hub ends of the housing.

To avoid the risk of premature damage to wheel bearings, they must be "prelubed" any time the wheel equipment is being installed. There are two methods of doing this. The correct method will depend on the type of wheel equipment being used.

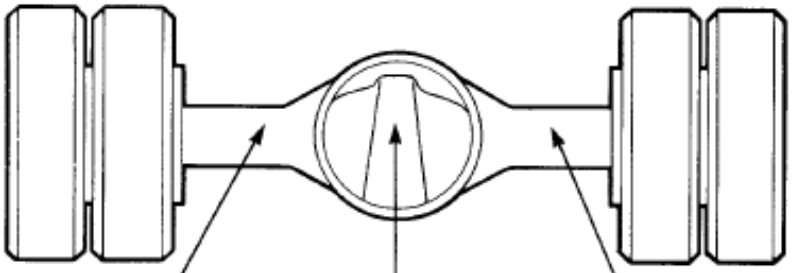


Hubs Equipped with Lube Filler Holes

Pour a pint of standard axle lubricant into the hub through the filler hole provided.

Lubrication when Hubs Have no Filler Holes

(Follow procedure in numerical sequence.)



1. Fill axle with lube through axle housing cover filler hole.

NOTE: For complete lubrication, instructions, see preceding pages.

2. Jack up left side of axle. Maintain this position for one minute to allow lube to flow into wheel ends at right side.

3. Jack up right side of axle. Maintain this position for one minute to allow lube to flow into wheel ends at left side.

4. With vehicle level again, add lube through axle housing cover filler hole. The axle should require two additional pints of lube to bring level up to bottom of filler hole.

Alternate Method

If conditions do not permit adding lube to wheel ends, pack the wheel bearings with good quality grease before assembly.

As the drive axle is disassembled, set all parts aside for thorough cleaning and inspection. Careful inspection will help determine whether parts should be reused. In many cases, the causes of premature wear or drive axle failure will also be revealed.

Cleaning

The differential carrier assembly may be steam-cleaned while mounted in the housing as long as all openings are tightly plugged. Once removed from its housing, do not steam clean differential carrier or any components. Steam cleaning at this time could allow water to be trapped in cored passages, leading to rust, lubricant contamination, and premature component wear. The only proper way to clean the assembly is to disassemble it completely. Other methods will not be effective except as preparatory steps in the process. Wash steel parts with ground or polished surfaces in solvent. There are many suitable commercial solvents available. Kerosene and diesel fuel are acceptable.

⚠ **WARNING:** GASOLINE IS NOT AN ACCEPTABLE SOLVENT BECAUSE OF ITS EXTREME COMBUSTIBILITY. IT IS UNSAFE IN THE WORKSHOP ENVIRONMENT.

Wash castings or other rough parts in solvent or clean in hot solution tanks using mild alkali solutions. If a hot solution tank is used, make sure parts are heated thoroughly, before rinsing.

Rinse thoroughly to remove all traces of the cleaning solution. Dry parts immediately with clean rags.

Lightly oil parts if they are to be reused immediately Otherwise, coat with oil and wrap in corrosion-resistant paper. Store parts in a clean, dry place.

Inspection

Inspect steel parts for notches, visible steps or grooves created by wear. Look for pitting or cracking along gear contact lines. Scuffing, deformation or discoloration are signs of excessive heat in the axle, usually related to low lubricant levels or improper lubrication practices.

Before reusing a gear set, inspect teeth for signs of excessive wear. Check tooth contact pattern for evidence of incorrect adjustment (see Adjustment Section for correct pattern).

Inspect machined surfaces of cast or malleable parts. They must be free of cracks, scoring, and wear. Look for elongation of drilled holes, wear on surfaces machined for bearing fits and nicks or burrs in mating surfaces.

Inspect fasteners for rounded heads, bends, cracks or damaged threads.

The axle housing should be examined for cracks or leaks. Also look for loose studs or cross-threaded holes.

Inspect machined surfaces for nicks and burrs.

Repair and Replacement

IMPORTANT: To achieve maximum value from an axle rebuild, replace lower-cost parts, such as thrust washers, seals, and bushings. These items protect the axle from premature wear or loss of lubricants. Replacing these parts will not increase rebuild cost significantly.

It is also important to replace other parts which display signs of heavy wear even though not cracked or broken. A significant portion of such a part's useful life has been expended and the damage caused, should the part fail, is far in excess of its cost.

Steel Parts — Gear sets, input and output shafts, differential parts and bearings are not repairable. Worn or damaged parts should be discarded without hesitation. Also discard mating parts in some cases. Gear sets for example, must be replaced in sets.

Miscellaneous Parts — Seals and washers are routinely replaced. None of these parts can be reused if damaged. Fasteners using self-locking nylon "patches" may be reused if not damaged, but should be secured by a few drops of Loctite #277 on the threaded surface of the hole during installation and carefully torqued during installation.

Axle Housings — Repairs are limited to removal of nicks or burrs on machined surfaces and the replacement of loose or broken studs.

⚠ **CAUTION:** ANY DAMAGE WHICH AFFECTS THE ALIGNMENT OR STRUCTURAL INTEGRITY OF THE HOUSING REQUIRES HOUSING REPLACEMENT. REPAIR BY WELDING OR STRAIGHTENING SHOULD NOT BE ATTEMPTED. THIS PROCESS CAN AFFECT THE HOUSING HEAT TREATMENT AND CAUSE IT TO FAIL COMPLETELY WHEN UNDER LOAD.

Silicone Rubber Gasket Compound — For more effective sealing, Spicer uses silicone rubber gasket compound to seal the majority of metal-to-metal mating surfaces.

Spicer includes gasket compound and application instructions in many repair parts kits.

It is recommended that this compound be used in place of conventional gaskets. The compound will provide a more effective seal against lube seepage and is easier to remove from mating surfaces when replacing parts.

Always use Spicer Genuine Axle Parts and Parts Kits.

Genuine Spicer replacement parts are the same high quality tolerances as the original axle components and include the latest engineering improvements.

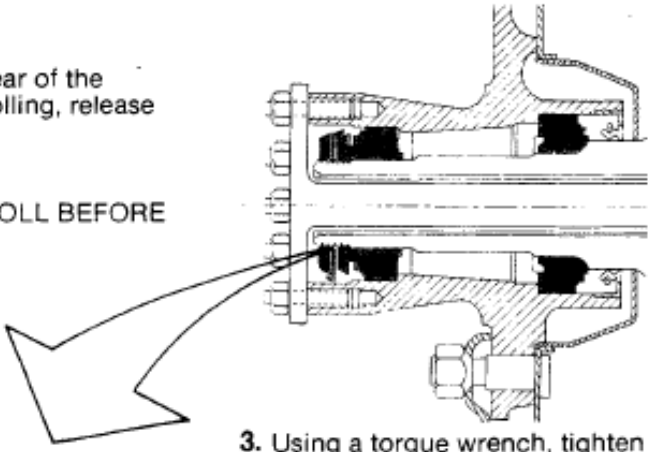
Parts Kits have only one part number which makes ordering, stocking and servicing easier. They are not only convenient, but give the advantage of having every part needed for a good repair job.

Wheel Bearings

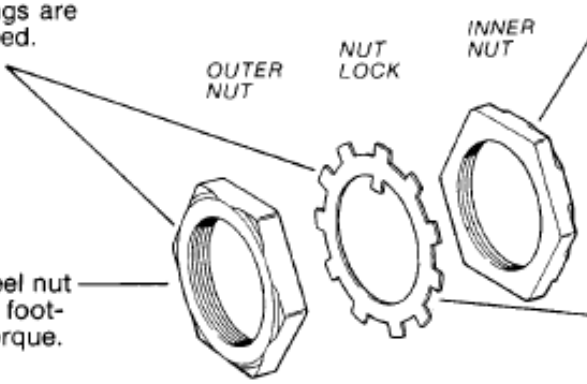
Wheel bearings should be adjusted at regular intervals using the following procedure:

1. Remove axle shafts. Jack the wheel to be adjusted clear of the ground. After securely blocking the vehicle to prevent rolling, release the parking brake, allowing the wheel to rotate freely.

⚠ **WARNING:** INSURE THAT THE VEHICLE WILL NOT ROLL BEFORE RELEASING BRAKES.



2. Remove outer adjusting nut and nut lock. Inspect the lock for serviceability. Replace if tangs are broken or badly misshaped.



3. Using a torque wrench, tighten the inner wheel nut with 50 foot-pounds (68 N·m) torque while rotating the wheel in both forward and reverse directions. The wheel should turn easily. Back off the inner wheel nut 1/4 to 1/3 turn.

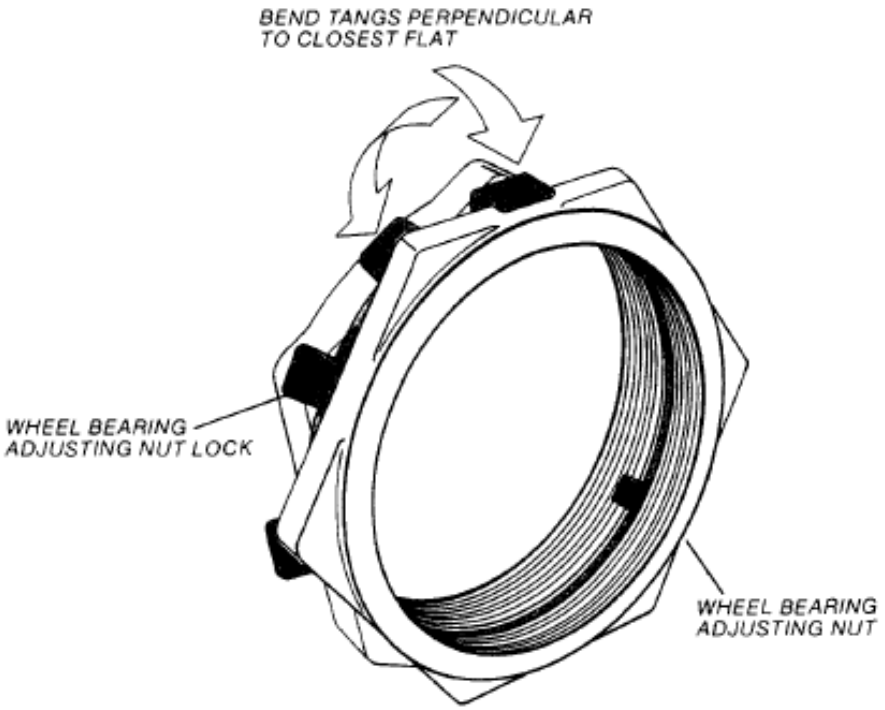
NOTE: Inner nut must be installed with machined shoulder surface placed against wheel bearing cone.

4. Install the nut lock and snug it to the inner wheel nut.

5. Replace the outer wheel nut and tighten to 250 to 275 foot-pounds (339-373 N·m) torque.

6. Repeat rotation of the wheel in both directions. The wheel should rotate freely within limits of 0.001" to 0.010" end play.

7. With adjustment complete, secure adjusting nuts by bending one wheel nut lock tang over each nut. Bend tangs over the closest flat perpendicular to the tang (see illustration). Reinstall the axle shaft.



Differential Carrier

Adjustments help provide optimum axle life and performance by correctly positioning bearings and gears under load.

The tandem axles covered in this manual require the following adjustments:

Bearing Preload: This adjustment is performed for both pinion and differential bearings. It maintains proper gear alignment by creating correct bearing cone and cup relationship for free rotation under load. The pinion pilot bearing does not require a preload adjustment.

Ring Gear Tooth Contact: This adjustment positions ring gear and pinion for best contact under load. Correct adjustment distributes torque evenly over gear teeth and helps maximize gear set life.

Input Shaft End Play: This adjustment controls gear mesh in the inter-axle differential.

Front Output Shaft End Play: This adjustment maintains correct relationship of the output shaft bearings and related parts.

Proper adjustment of both input and output shafts help maximize life of all power divider parts.

Adjust Input Shaft End Play

Specifications: Input shaft end play requirements will vary with operating conditions, mileage and rebuild procedures. These variations are shown in the following chart.

Input Shaft End Play Chart

New or Rebuild with new parts 0.003" to 0.007"	**NOTE:** Because of manufacturing variations in individual parts, correctly adjusted end play could vary 0.010", after the unit is rotated.
Rebuild with reused parts 0.013" to 0.017"	

Acceptable End Play Tolerances when measuring as a regular maintenance procedure with axle in truck.

Up to 0.060" with over 100,000 miles or 1 year service off-road.	**NOTE:** If end play exceeds limits, disassemble power divider and replace worn parts.
Up to 0.040" with less than 100,000 miles or 1 year service on-road.	

Measuring End Play with Dial Indicator.

Measure and Adjust End Play.

1. With power divider assembled to differential carrier, measure end play with dial indicator positioned at yoke end of input shaft. Move input shaft axially and measure end play. If end play is not correct (see chart), adjust as follows.

2. Remove input shaft nut, flat washer and yoke. Remove bearing cover cap screws and lockwashers. Remove cover and shim pack.

3. To increase end play, add shims:

Desired end play	0.003" to 0.007"
Measured end play (Step 1)	0.001" — 0.001"
Add shims to provide desired end play	0.002" to 0.006"

4. To decrease end play, remove shims:

Measured end play (Step 1)	0.015" — 0.015"
Desired end play	0.003" to 0.007"
Remove shims to provide desired end play	0.012" to 0.008"

5. To reassemble input shaft, install the adjusted shim pack and bearing cover. Install cap screws and lockwashers. Torque screws to 75-85 ft-lbs. (101-115 N·m).

6. Install yoke, flat washer and nut. Tighten nut snugly. Tap end of input shaft lightly to seat bearings.

7. Measure input shaft end play with dial indicator. If end play is still incorrect, repeat Steps 2 through 6.

8. With end play correct, seal shim pack to prevent lube leakage, then torque input shaft nut and cover cap screws (see chart).

NOTE: When power divider has been disassembled and reassembled, it may be desirable to adjust end play by measuring bearing cover clearance and calculating shim pack size. For procedures, see Power Divider Section 4.

Torque Chart

	Ft-lbs.	N·m
Input Shaft Nut		
1-5/8-18	780-960	1059-1301
1-7/8-12	840-1020	1139-1383
Bearing Cover Cap Screw		
1/2-13 (Grade 5)	75-85	101-115

NOTE: If difficulty is experienced in achieving correct torque on the input yoke nut, torque the nut with truck on the ground and axle shafts installed.

Adjust Front Output Shaft End Play

NOTE: The following instructions apply to a completely assembled differential carrier and power divider. For instructions during reassembly when overhauling power divider, refer to Power Divider Overhaul Section 4.

Specifications: 0.003" to 0.007" shaft end play.

Measure and Adjust End Play.

1. Measure end play with dial indicator positioned at yoke end of output shaft. If end play is not correct, adjust as follows:

2. Remove Front Output Shaft Assembly: Remove two shift unit cap screws and lockwashers. Remove four output cover cap screws and lockwashers. Then remove output shaft assembly (shaft, cover, gear, yoke and shift unit) from power divider cover. Remove shim pack.

3. To increase end play, add shims:

Example: Desired end play	0.003" to 0.007"
Measured end play (Step 1)	0.001" — 0.001"
Add shims to provide desired end play	0.002" to 0.006"

4. To decrease end play, remove shims:

Example: Measured end play	0.015" — 0.015"
Desired end play	0.003" to 0.007"
Remove shims to provide desired end play	0.012" to 0.008"

5. Adjust shim pack size as necessary. Reassemble adjusted shim pack and output shaft assembly to power divider cover. Install only the four output cover cap screws and lockwashers to recheck end play. Torque cap screws (see chart).

6. Recheck shaft end play. If end play is incorrect, remove shaft assembly and readjust shim pack (Steps 2 thru 5). When end play is correct, proceed to Step 7.

7. Final Shaft Assembly after End Play Is Correct:
IMPORTANT: Removing and installing output shaft as an assembly during adjustment procedure could possibly damage oil seal. When this procedure is used, it is recommended that a new oil seal be installed.

8. After shaft end play is correctly adjusted, remove the four cover cap screws and lockwashers. Remove output shaft, cover and yoke assembly. Coat mounting surfaces of both output and power divider covers with sealant to prevent lube leakage.

9. Assemble shim pack and output shaft assembly to power divider cover. Install four cap screws and lockwashers fastening output cover but do not tighten cap screws completely.

10. Before installing shift unit cap screws, apply silicone gasket compound to the mounting surface of the output cover (see illustration). If difficulty is experienced, remove shift unit (see Shift System, Section 8). With compound applied, install shift unit cap screws. Torque output cover and shift unit cap screws (see chart). To prevent possible lube leakage, coat outer edge of shim pack with sealant.

11. At this point in reassembly, remove yoke and replace oil seal. Reinstall yoke, flat washer and nut. Torque nut (see chart).

Torque Chart

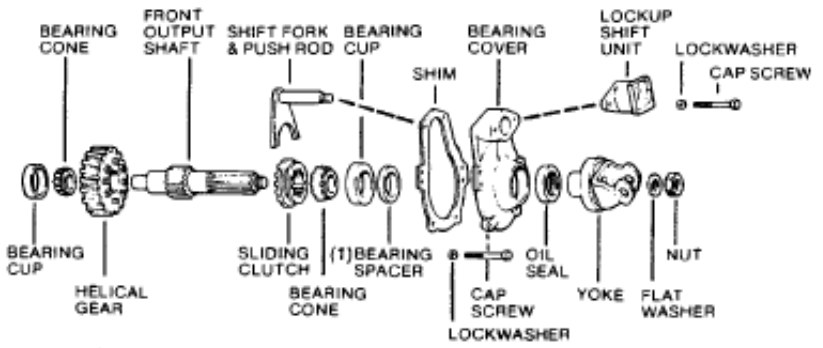
Front Output Shaft Cover

Cap Screw	Ft-lbs.	N·m
7/16-14 (two) (Grade 5)	48-56	65-76
9/16-12 (four) (Grade 5)	110-125	149-170

Output Shaft

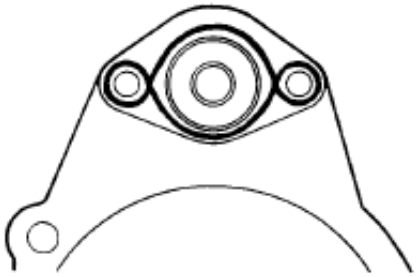
Nut	Ft-lbs.	N·m
1-1/2-18	560-700	759-949

Front Output Shaft



(1) Used only on 185, 220 Series.

Silicone Gasket Compound Pattern. Lockup Shift Unit.



Adjust Pinion Bearing Preload for Axles with "Press-fit" Outer Pinion Bearings

Trial Build-up

1. Assemble pinion bearing cage, bearings, spacer and spacer washer (without drive pinion or oil seal). Center bearing spacer and spacer washer between two bearing cones.

NOTE: When new gear set or pinion bearings are used, select nominal size spacer from the specification chart below. If original parts are used, use spacer removed during disassembly.

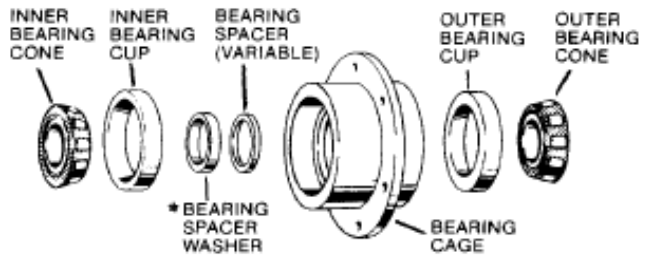
2. With the bearings well lubricated, place the assembly in the press. Position sleeve so that load is applied directly to the back-face of the outer bearing cone.

3. Apply press load (see chart below) to the assembly and check rolling torque. Wrap soft wire around the bearing cage, attach spring scale and pull. Preload is correct when torque required to rotate the pinion bearing cage is from 10-20 inch-pounds. This specification is translated into spring scale readings in the chart below.

4. If necessary, Adjust Pinion Bearing Preload by changing the pinion bearing spacer. A thicker spacer will decrease preload. A thinner spacer will increase preload.

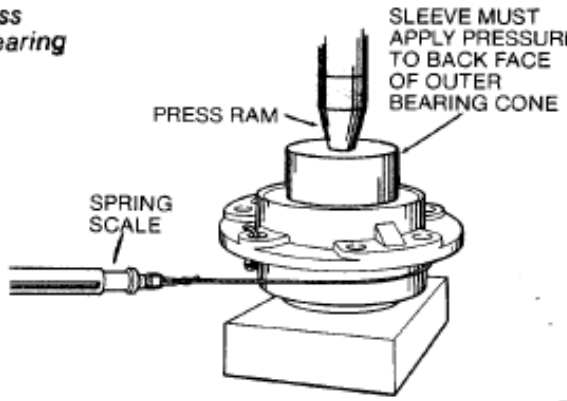
IMPORTANT: Once correct bearing preload has been established, note the spacer size used. Select a spacer 0.001" larger for use in the final pinion bearing cage assembly. The larger spacer compensates for slight "growth" in the bearings which occurs when they are pressed on the pinion shank. The trial build-up will result in proper pinion bearing preload in three of four cases.

Assemble these Parts for Trial Build-up.



*Used only on Axle Series 230, 260, 300, 350.

Cage in Press to Check Bearing Preload.



IMPORTANT: Do not assume that all assemblies will retain proper preload once bearings are pressed on pinion shank. FINAL PRELOAD TEST MUST BE MADE IN EVERY CASE.

Specifications for Pinion Bearing Trial Build-up Preload Test ("Press-fit" Outer Pinion Bearings)					Spring Scale Reading (without pinion seal) (for 10-20 in-lbs. torque) (1.1-2.3 N·m)	
	Nominal Bearing Spacer Thickness		Press Loads			
Axle Series	in.	mm	Tons	Metric Tons	lbs.	kgs.
185, 220	0.496	12.6	17-19	15.4-17.2	3-7	2-3
230, 260, 300, 350	0.185	4.699	18-20	16.3-18	3-7	2-3

Final Pinion Bearing Preload Test

1. Assemble the complete pinion bearing cage unit as recommended in the assembly section of this manual.

NOTE: Forward axle pinion is equipped with helical gear. For easier disassembly during bearing adjustment procedure, use a dummy yoke (if available) in place of helical gear.

2. Apply clamp load to the pinion bearing cage assembly. Either install the yoke (or helical gear) and torque the pinion nut to specifications or use a press to simulate nut torque (see chart below).

Vise Method — If the yoke and nut are used, mount the assembly in a vise, clamping yoke firmly.

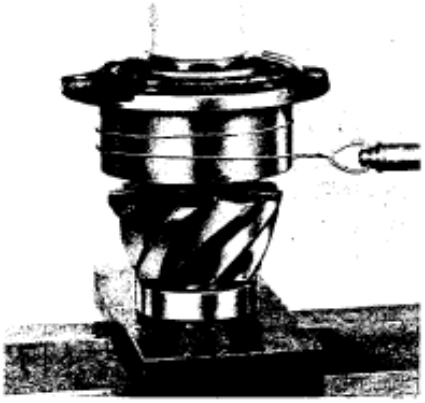
Press Method — If a press is used, position a sleeve or spacer so that load is applied directly to the back-face of the outer bearing cone.

3. Measure Pinion Bearing Preload — Use a spring scale to test the assembly rolling torque. To use the spring scale, wrap soft wire around the bearing cage, attach the scale and pull. Preload is correct when torque required to rotate the pinion bearing cage is from 15 to 35 inch pounds. This specification is translated into spring scale readings in the chart below.

4. Adjust Pinion Bearing Preload — If necessary, adjust pinion bearing preload. Disassemble the pinion bearing cage as recommended in this manual and change the pinion bearing spacer. A thicker spacer will decrease preload. A thinner spacer will increase preload.

IMPORTANT: Use the correctly sized spacer. Do not use shim stock or grind spacers. These practices can lead to loss of bearing preload and gear or bearing failure.

Measuring Bearing Preload with Pinion in Vise.



Measuring Bearing Preload with Pinion in Press.

Specifications for Final Pinion Bearing Preload Test ("Press-fit" Outer Pinion Bearings)					Spring Scale Reading (without pinion seal) (for 15-35 in-lbs. torque) (1.7-4 N·m)	
	Nut Torque		Press Loads			
Axle Models	**Ft-lbs.**	**N·m**	**Tons**	**Metric Tons**	**lbs.**	**kgs.**
185, 220	840*	1139*	17-19	15.4-17.2	5-12	2-5
230, 260, 300, 350	980*	1329*	18-20	16.3-18	5-12	2-5

*Torque nut to torque shown above, then continue tightening nut to align slot to nearest hole in pinion shank.

Differential Bearing Preload and Ring Gear Backlash Adjustment

Correct differential bearing preload insures proper location of these bearings under load and helps position the ring gear for proper gear tooth contact.

(Follow procedures in numerical sequence.)

Adjust Diff. Bearing Preload

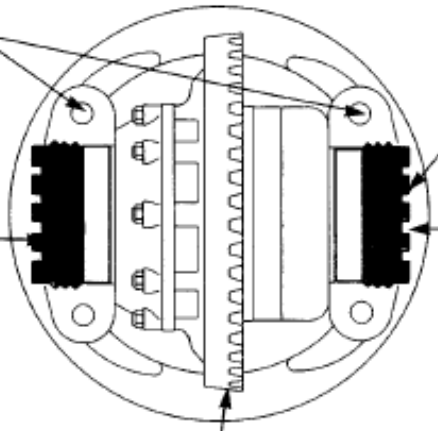
1. Lubricate differential bearings.

IMPORTANT: When installing bearing caps and adjuster, exert care not to cross threads.

2. Install adjusters and bearing caps. Tighten bearing cap screws finger-tight. If this is difficult, use a hand wrench.

NOTE: Ring gear position for rear axle is illustrated.

3. Loosen the bearing adjuster on the same side as the ring gear teeth until its first thread is visible.



4. Tighten the bearing adjuster on the back-face side of the ring gear until there is no backlash.

This can be tested by facing the ring gear teeth and pushing the gear away from the body while gently rocking the gear from side to side. There should be no free movement.

Rotate the ring gear and check for any point where the gear may bind. If such a point exists, loosen and retighten the back side adjuster. Make all further adjustments from the point of tightest mesh.

5. At teeth side of ring gear, tighten adjuster until it contacts the bearing cup. Continue tightening adjuster two or three notches and this will preload bearings and provide backlash.

6. Measure backlash with a dial indicator.

USED GEARING — Reset to backlash recorded before disassembly.
NEW GEARING — Backlash should be as follows:

Axle Series 185, 220	**0.006" to 0.016"**
Axle Series 230, 260, 300, 350	**0.008" to 0.018"**

If backlash is incorrect, proceed as described below to readjust.

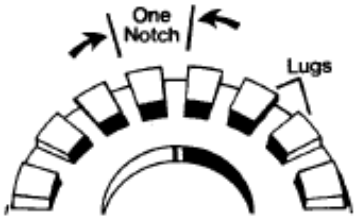
Adjust Ring Gear Backlash

To **add** backlash: Loosen the adjuster on the teeth side of the ring gear several notches. Loosen the opposite adjuster one notch.

Return to adjuster on teeth side of the ring gear and tighten adjuster until it contacts the bearing cup. Continue tightening the same adjuster 2 or 3 notches. Recheck backlash.

To **remove** backlash: Loosen the adjuster on the teeth side of the ring gear several notches. Tighten the opposite adjuster one notch.

Return to adjuster on teeth side of ring gear and tighten adjuster until it contacts the bearing cup. Continue tightening the same adjuster 2 or 3 notches. Recheck backlash.



Moving adjuster one notch is the movement of the lead edge of one adjuster lug to the lead edge of the next lug past a preselected point.

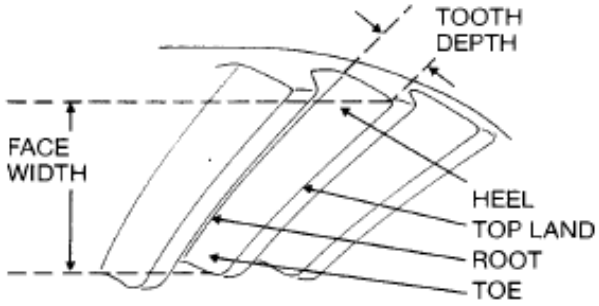
Ring Gear and Pinion Tooth Contact

NOTE: Rear axle gearing is shown in the following instructions. Correct tooth contact patterns and adjustments are the same for forward and rear axles.

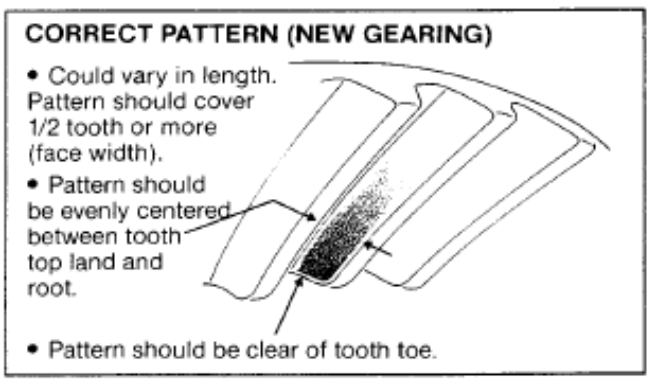
Check Tooth Contact Pattern (NEW GEAR)

Paint twelve ring gear teeth with marking compound and roll the gear to obtain a contact pattern. The correct pattern is well-centered on the ring gear tooth with lengthwise contact clear of the toe. The length of the pattern in an unloaded condition is approximately one-half to two-thirds of the ring gear tooth in most models and ratios.

RING GEAR TOOTH NOMENCLATURE



CORRECT PATTERN (NEW GEARING)

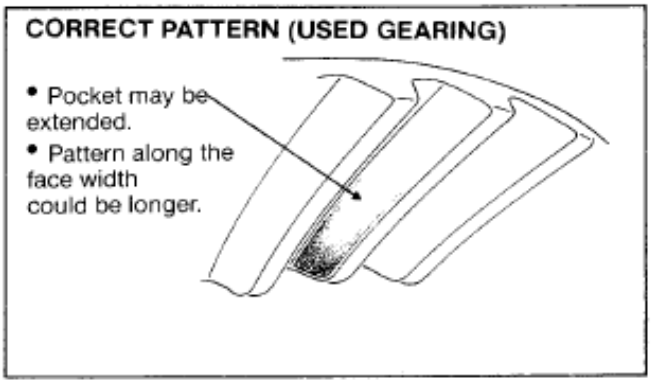

• Could vary in length. Pattern should cover 1/2 tooth or more (face width).
• Pattern should be evenly centered between tooth top land and root.
• Pattern should be clear of tooth toe.

Check Tooth Contact Pattern (USED GEAR)

Used gearing will not usually display the square, even contact pattern found in new gear sets. The gear will normally have a "pocket" at the toe-end of the gear tooth which tails into a contact line along the root of tooth. The more use a gear has had, the more the line becomes the dominant characteristic of the pattern.

Adjust used gear sets to display the same contact pattern observed before disassembly. A correct pattern is clear of the toe and centers evenly along the face width between the top land and root. Otherwise, the length and shape of the pattern are highly variable and is considered acceptable as long as it does not run off the tooth at any point.

CORRECT PATTERN (USED GEARING)



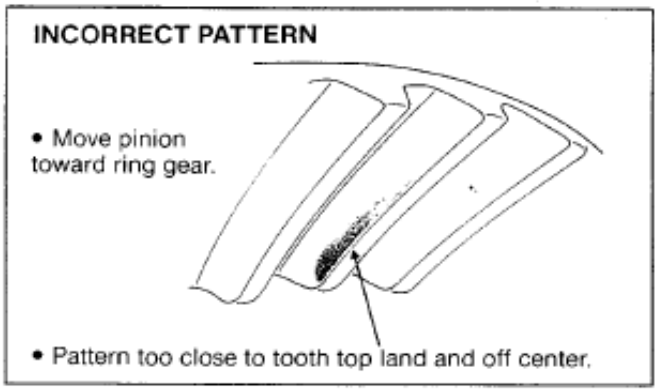
Adjust Tooth Contact Pattern

If necessary, adjust the contact pattern by moving the ring gear and drive pinion. Ring gear position controls the backlash. This adjustment moves the contact pattern along the face width of the gear tooth. Pinion position is determined by the size of the pinion bearing cage shim pack. It controls contact on the tooth depth of the gear tooth.

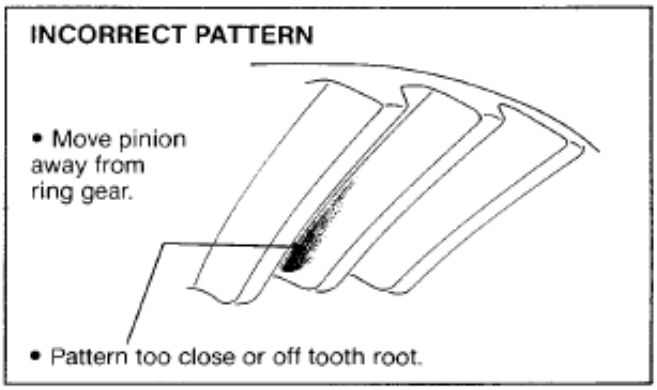
These adjustments are interrelated. As a result, they must be considered together even though the pattern is altered by two distinct operations. When making adjustments, first adjust the pinion, then the backlash. Continue this sequence until the pattern is satisfactory.

Adjust Pinion Position

If the gear pattern shows incorrect tooth depth contact, change drive pinion position by altering the shim pack. Used gears should achieve proper contact with the same shims removed from the axle at disassembly.



If the pattern is too close to the top land of the gear tooth, remove pinion shims.

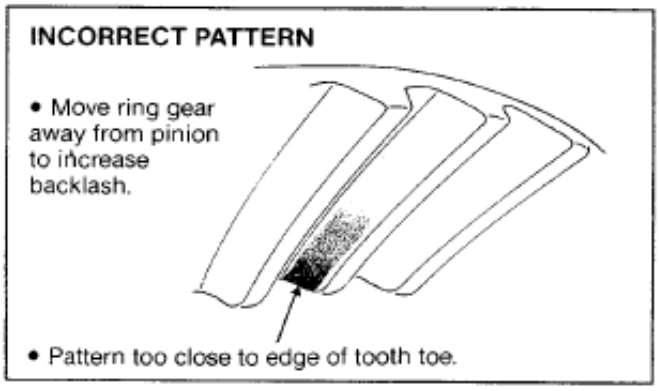


If the pattern is too close to the root of the gear tooth, add pinion shims.

NOTE: Check ring gear backlash after each shim change and adjust if necessary to maintain:
0.006" to 0.016" for Axle Series 185, 220; 0.008" to 0.018" for Axle Series 230, 260, 300, 350

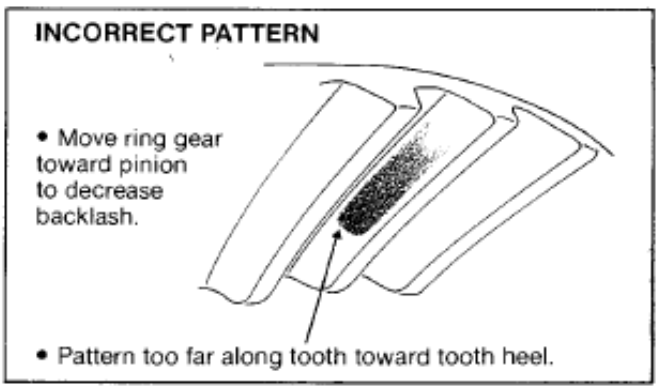
Adjust Backlash

If the gear pattern shows incorrect face width contact, change backlash.



With the pattern concentrated at the toe (too far down the tooth), **add backlash** by loosening the bearing adjuster on the teeth side of ring gear several notches. Loosen the opposite adjuster one notch.

Return to adjuster on teeth side of ring gear and tighten adjuster until it contacts the bearing cup. Continue tightening the same adjuster 2 or 3 notches. Recheck backlash.



If the pattern is concentrated at the heel (too far up the tooth), **remove backlash** by loosening the bearing adjuster on the teeth side of ring gear several notches. Tighten the opposite adjuster one notch.

Return to adjuster on teeth side of ring gear and tighten adjuster until it contacts the bearing cup. Continue tightening the same adjuster 2 or 3 notches. Recheck backlash.

Remove Differential Carrier Assembly from Axle Housing

1. Drain axle lube.

2. Dual Range Axle: Shift to low range. Disconnect shift unit air line. Remove shift unit.

3. Axle with Controlled Traction Differential: Shift to engaged position. Disconnect shift unit air line. Remove shift unit.

4. Disconnect front output shaft driveline (to steer-drive axle). Loosen shaft nut but do not remove.

5. Disconnect lockup shift unit air lines.

6. Disconnect input driveline. Loosen shaft nut but do not remove.

7. Remove stud nuts and axle shafts. (If used, remove lockwashers and taper dowels.) If necessary, loosen dowels by holding a brass drift in the center of the shaft head and striking drift a sharp blow with a hammer.

IMPORTANT: Do not strike the shaft head with a hammer. Do not use chisels or wedges to loosen shaft or dowels.

8. Support differential carrier with transmission jack or similar equipment. Remove nuts and lockwashers (some models also use capscrews) fastening carrier to axle housing. Remove differential carrier and power divider assembly.

WARNING: DO NOT LIE UNDER CARRIER AFTER FASTENERS ARE REMOVED. USE TRANSMISSION JACK TO SUPPORT DIFFERENTIAL CARRIER ASSEMBLY.

Torque Chart

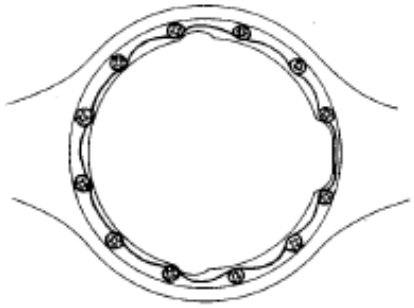
	Size	Grade	Ft-lbs.	N·m
DIFFERENTIAL CARRIERS				
	(Axle Series 185, 220)			
Stud/Nut	5/8-18	(8 stud)	220-240	298-325
	(Axle Series 230, 260, 300, 350)			
Stud/Nut	5/8-18	(8 stud)	220-240	298-325
		(At Dowels)	150-170	203-230
Cap Screw (12 pt.)	5/8-11	(8)	210-230	285-312
AXLE HOUSING COVERS				
Stud/Nut	**(Axle Series 185, 220, 230, 260)**			
	7/16-20	(8 stud)	70-86	94-116
Cap Screw	7/16-14	(5)	48-56	65-75
	(Axle Series 300, 350)			
Stud/Nut	1/2-20	(8 stud)	110-130	149-176
Cap Screw	1/2-13	(5)	75-85	101-115
SHIFT UNIT				
	(Dual Range)			
Stud/Nut	7/16-20	(8 stud)	55-61	74-82

Install Differential Carrier Assembly

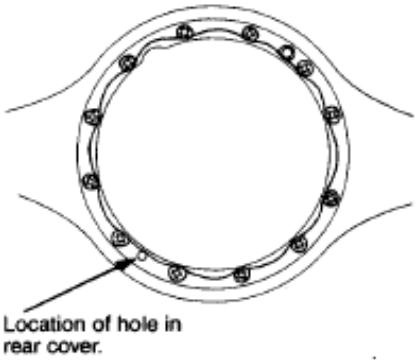
IMPORTANT: Before installing carrier assembly, inspect and thoroughly clean interior of axle housing.

NOTE: Use silicone rubber gasket compound on axle housing mating surface as shown in the illustrations. Gasket compound will set in 20 minutes. Install carrier and axle housing cover before compound sets or reapply.

SILICONE GASKET COMPOUND PATTERN. DIFFERENTIAL CARRIER MATING SURFACE.



SILICONE GASKET COMPOUND PATTERN. HOUSING COVER MATING SURFACE.



(Follow procedure in numerical sequence.)

1. Dual Range Axle: Shift to low range.

2. Axle with Controlled Traction Differential: Shift to engaged position.

3. Apply silicone gasket compound. Install differential carrier assembly in axle housing. Install nuts and lockwashers. Some Axle Models also use cap screws. Tighten fasteners to correct torque (see chart, page 3—15).

4. Install axle shafts and stud nuts. (If used, also install lockwashers and taper dowels.)

5. Connect front output shaft driveline (to steer-drive axle).

6. Connect input shaft driveline.

7. Fill axle with correct lube (see Lubrication Section).

8. Connect lockup shift unit air lines.

9. Dual Range Axle. Install shift unit, nuts and lockwashers. Tighten to correct torque (see chart, page 3—15). Connect air line.

10. Axle with Controlled Traction Differential: If used, install shift unit, nuts and lockwashers. Torque nuts (see chart, page 3—15). Connect air line.

IMPORTANT: When axle has been disassembled or housing, gears, axle shafts or wheel equipment replaced, check axle assembly for proper differential action before operating vehicle. Wheels must rotate freely and independently.

Power Divider Overhaul

These instructions cover all 4x4 rear axle power dividers. It is assumed that the differential assembly has been removed from the axle housing.

Contents — **Section 4, Page No.**

POWER DIVIDER OVERHAUL

Transfer Gearing Description 2

Remove Power Divider from Differential Carrier 2

ALL MODELS

Disassemble Front Output Shaft 3

Assemble Front Output Shaft 3

185, 220 AXLE SERIES

Disassemble Power Divider Cover 4

Install Input Shaft and Power Divider on Differential Carrier 5

230, 260, 300, 350 AXLE SERIES

Disassemble Power Divider Cover 6

Assemble Power Divider Cover and Input Shaft, then Install Power Divider on Differential Carrier 7

ALL MODELS

Adjust Input Shaft End Play 8

Adjust Front Output Shaft End Play and Final Assembly of Output Shaft 9

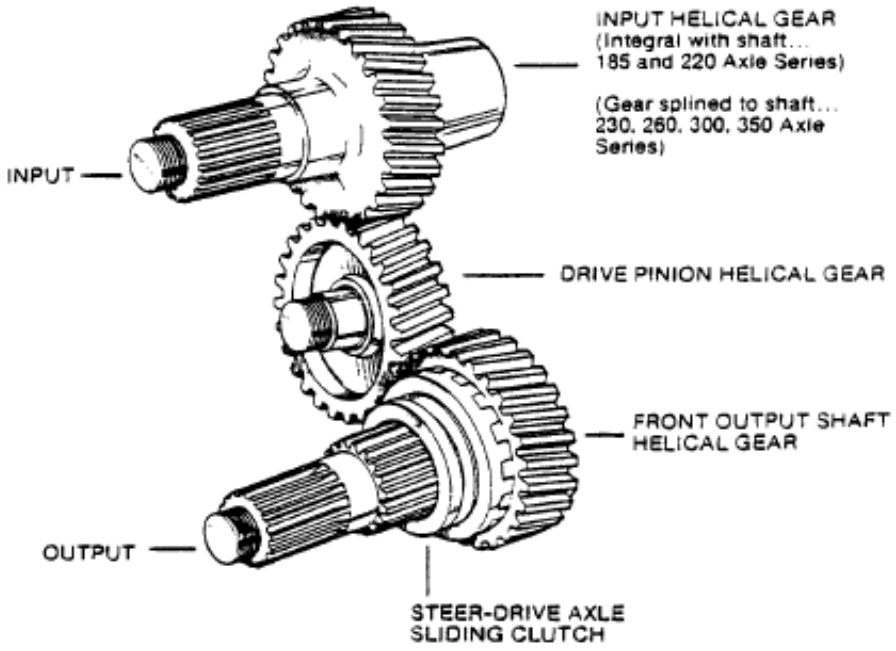
Description

The transfer gearing consists of three gears:

1. Input shaft and helical gear (Integral component on 185 and 220 Axle Series) (Helical gear is splined to input shaft on 230, 260, 300, 350 Axle Series).
2. Drive Pinion helical gear (splined to pinion shaft).
3. Output Shaft helical gear (gear floats on shaft).

The output shaft is equipped with a sliding clutch. This clutch engages or disengages helical gear to control power flow to the steer-drive axle.

The output shaft sliding clutch is operated by an air type lockup shift unit.


INPUT HELICAL GEAR
(Integral with shaft... 185 and 220 Axle Series)
(Gear splined to shaft... 230, 260, 300, 350 Axle Series)
INPUT
DRIVE PINION HELICAL GEAR
FRONT OUTPUT SHAFT HELICAL GEAR
OUTPUT
STEER-DRIVE AXLE SLIDING CLUTCH

Remove Power Divider from Differential Carrier

(with carrier removed from axle housing)

1. Mount differential carrier in repair stand. Loosen input shaft nut.

NOTE: There are blind cap screws fastening power divider cover to differential carrier. These cap screws are accessible through front output shaft bearing cover opening. Before attempting to remove power divider cover, first remove front output shaft assembly to make these cap screws accessible (see step **2**).

2. Remove Front Output Shaft Assembly: Remove two shift unit cap screws and lockwashers. Remove four output cover cap screws and lockwashers. Then remove output shaft assembly (shaft, cover, gear, yoke and shift unit) from power divider cover. Remove shim pack.

3. Remove power divider cover cap screws (including the blind cap screws). Two blind screws are used on 185 and 220 Axle Series; one screw is used on 230, 260, 300, 350 Axle Series.

4. To remove power divider cover assembly, attach chain hoist to input shaft yoke and lift the cover assembly off carrier. If power divider cover does not separate easily, strike cover near dowel pin locations with a soft mallet.

NOTE: Lifting mechanism may create nicks and burrs on yoke. Remove nicks and burrs if present.

Disassemble Front Output Shaft

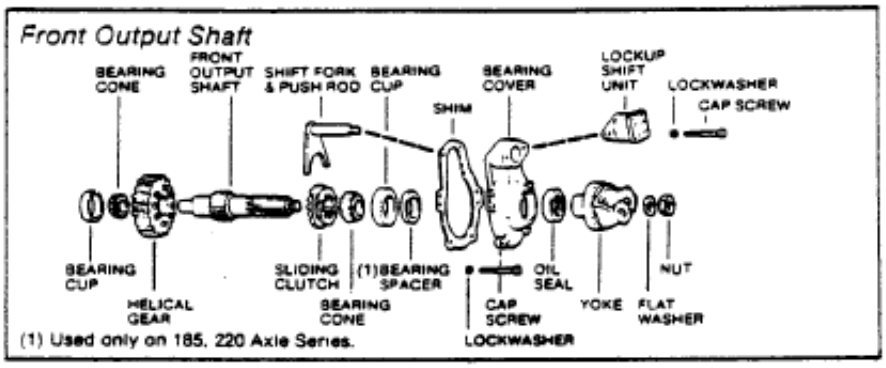
1. Disassemble and remove lockup shift unit from output shaft cover (see Shift System, Section 8).

2. Remove nut, flat washer and yoke from shaft. Remove cover assembly and shift fork.

NOTE: On 185, 220 Axle Series, remove bearing spacer from output shaft.

3. To disassemble output cover, remove oil seal and bearing cup using suitable pullers.

4. To disassemble output shaft, place assembly in press (helical gear up). Press inner bearing cone and gear off shaft.



5. Remove outer bearing cone using split-type puller. Remove sliding clutch.

6. If replacement is necessary, remove inner bearing cup from power divider cover, using suitable puller.

Assemble Front Output Shaft

1. Mount output shaft in press (yoke splines down). Install helical gear on shaft with clutch teeth down (facing yoke splines).

2. Press inner (small) bearing cone on output shaft.

IMPORTANT: To prevent bearing damage, be careful to use sleeve that only contacts inner race of bearing cone. After bearing cone installation, helical gear should rotate freely.

3. Reverse position of output shaft in press (yoke splines up). Place sliding clutch on shaft splines with clutch teeth facing helical gear.

4. Press outer (large) bearing cone on shaft.

IMPORTANT: To prevent bearing damage, be careful to use sleeve that only contacts inner race of bearing cone.

5. On 185, 220 Axle Series only, install bearing spacer washer on spline end of output shaft.

6. To assemble bearing cover, press bearing cup in cover.

IMPORTANT: For correct cup installation, use appropriate sleeve. Take care to make sure cup is not cocked and is firmly seated all around.

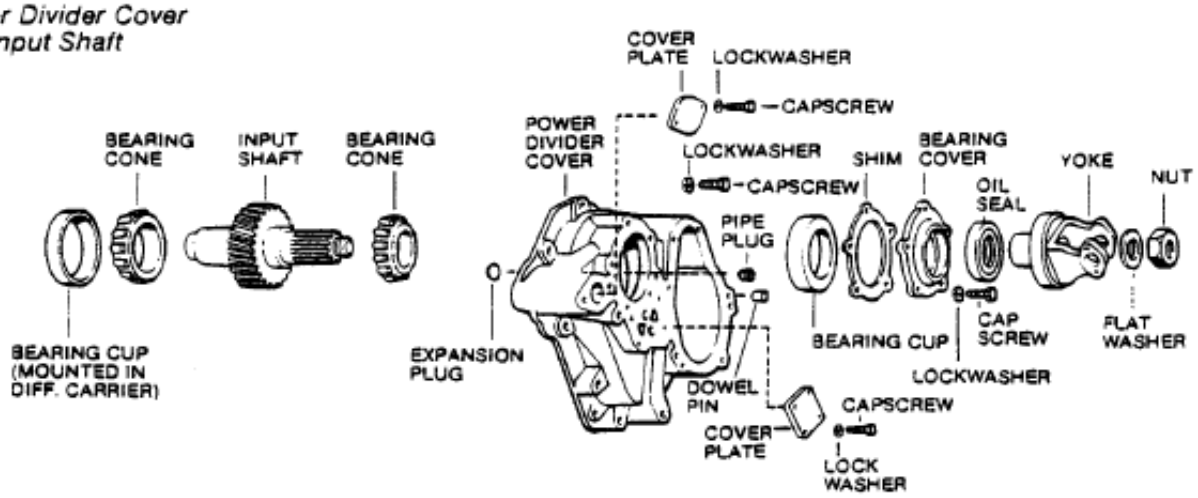
NOTE: Do not install oil seal in output cover until output shaft end play adjustment is completed.

NOTE: At this point in reassembly, the output shaft assembly and output cover are ready to install for purposes of measuring cover clearance and adjusting output shaft end play (page 4—9).

NOTE: When adjustment of output shaft end play is completed, continue reassembly as described on page 4—9.

Disassemble Power Divider Cover (185 and 220 Axle Series)

Power Divider Cover and Input Shaft



IMPORTANT: Input shaft and helical gear are manufactured as one component. When yoke is removed in Step 1 procedure, exert caution because the shaft and gear (with bearing cones) could fall out of power divider cover.

1. Remove nut, flat washer and yoke from input shaft. Remove input shaft, helical gear and bearing cone assembly.

2. Remove two bearing cones from input shaft using suitable pullers.

3. Remove cap screws, lockwashers, input bearing cover and shim pack from power divider cover.

4. Remove oil seal and bearing cup from input bearing cover, using suitable pullers.

5. Remove input rear bearing cup from differential carrier, using suitable puller.

6. Remove snap ring securing pinion outer support bearing race.

⚠ **WARNING:** SNAP RING IS SPRING STEEL AND MAY POP OUT. WEAR SAFETY GLASSES WHEN REMOVING.

Remove pinion outer support bearing race, using suitable puller.

7. Remove front output shaft bearing cup from power divider cover, using suitable puller.

Torque Chart

Input Shaft Nut	**Ft-lbs.**	**N·m**
1-5/8-18	780-960	1059-1301
Cover Plate Cap Screws		
7/16-14 (Grade 5)	48-56	65-76
Power Divider Cover Cap Screws		
9/16-12 (Grade 5)	110-125	149-170
Input Shaft Bearing Cover Cap Screws		
1/2-13 (Grade 5)	75-85	101-115

Install Input Shaft and Power Divider Cover on Differential Carrier

(185 and 220 Axle Series)

1. Check expansion plug in power divider cover to make sure it is in place and firmly seated. If loose, seat by tapping with hammer. Replace plug if necessary.

NOTE: Install the following parts (Step **2** through Step **6**) if they were removed.

2. Press front output shaft bearing cup in power divider.

3. Install pinion outer support bearing race in power divider cover, using a driver and hammer or a press and suitable sleeve. Install snap ring to secure bearing race.

⚠ **WARNING:** SNAP RING IS SPRING STEEL AND MAY POP OFF. WEAR SAFETY GLASSES WHEN INSTALLING.

4. Apply silicone gasket compound to cover plate mounting surfaces on power divider cover. Install cover plate and fasten with cap screws and lockwashers. Torque cap screws (see chart).

5. Install input shaft rear bearing cup in differential carrier.

6. Press bearing cup in input shaft bearing cover.

7. NOTE: Do not install oil seal until input shaft end play adjustment is completed (page 4—8).

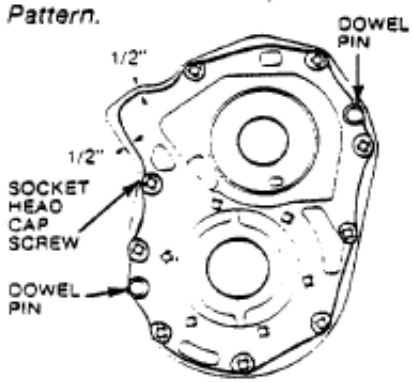
8. Press bearing cones on each end of input shaft.

IMPORTANT: To prevent bearing damage, be careful to use a sleeve that only contacts inner race of bearing cone.

9. If removed, install dowel pins in differential carrier.

10. Apply silicone gasket compound to carrier mating surface (see illustration).

Silicone Gasket Compound Pattern.



185, 220 Axle Series

11. Place input shaft, gear and bearing assembly in carrier then install power divider cover.

IMPORTANT: When installing cover make sure pinion outer support bearing is aligned with bearing race.

Install cap screws and lockwashers, placing socket-head cap screws at location shown on gasket compound drawing.

NOTE: Make sure the two blind cap screws are installed (through output shaft bearing cover opening).

Tighten cap screws to correct torque (see chart, page 4—4).

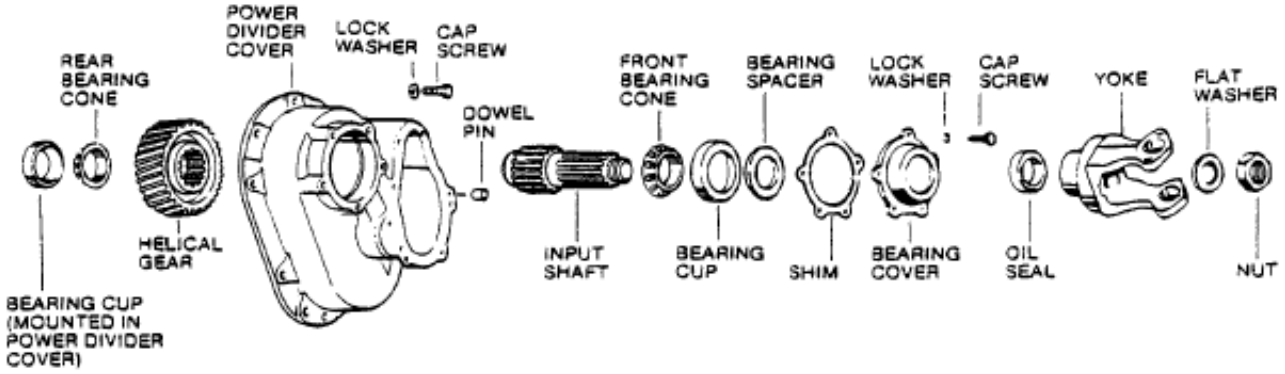
12. With power divider and input shaft installed on carrier, adjust input shaft end play. Temporarily, install input bearing cover (without shims) and follow procedures in Step 2 through 9, page 4—8.

13. After input shaft end play is correct, make sure bearing cover nuts and input shaft nut are torqued properly (see chart, page 4—4). Also, seal shim pack to prevent lube leakage (Step 9, page 4—8).

14. Install front output shaft and adjust end play (see page 4—9).

Disassemble Power Divider Cover (230, 260, 300, 350 Axle Series)

Power Divider Cover and Input Shaft



1. Remove nut, flat washer and yoke from input shaft.

2. Remove cap screws, lockwashers, input bearing cover and shim pack from power divider cover.

3. Remove bearing spacer from input shaft.

4. Place power divider cover in press (inside area up) and press input shaft out of rear bearing cone. Then remove helical gear and rear bearing cone from power divider cover.

5. Remove oil seal and bearing cup from input bearing cover, using suitable pullers.

6. To remove front bearing cone from input shaft, temporarily place helical gear on input shaft. Place shaft in press and remove bearing cone.

7. Remove input rear bearing cup from power divider, using suitable puller.

8. Remove snap ring securing pinion outer support bearing race.

WARNING: SNAP RING IS SPRING STEEL AND MAY POP OUT. WEAR SAFETY GLASSES WHEN REMOVING.

Remove pinion outer support bearing race, using suitable puller.

9. Remove front output shaft bearing cup from power divider cover, using suitable puller.

Torque Chart

	Ft-lbs.	N-m
Input Shaft Nut		
1-7/8-12	840-1202	1139-1383
Input Shaft Bearing Cover Cap Screws		
1/2-13 (Grade 5)	75-85	101-115
Power Divider Cover Cap Screws		
9/16-12 (Grade 5)	110-125	149-170

Assemble Power Divider Cover and Input Shaft then Install Cover and Shaft Assembly on Differential Carrier

(230, 260, 300, 350 Axle Series)

1. If removed, press front output shaft rear bearing cup in power divider cover.

2. If removed, install pinion outer support bearing race in power divider cover, using a driver and a hammer or a press and suitable sleeve.

3. Install snap ring to secure bearing race.

WARNING: SNAP RING IS SPRING STEEL AND MAY POP OFF. WEAR SAFETY GLASSES.

4. IMPORTANT: Assemble and install input shaft in power divider cover before cover is installed on carrier (Steps **5** through **7**).

NOTE: Install front output shaft and adjust end play after power divider cover is installed on carrier. A blind cap screw fastens power divider cover and it is only accessible through output shaft opening (see page 4—9).

5. Press bearing cup in input bearing cover.

NOTE: Do not install oil seal until input shaft end play adjustment is completed (see page 4—8).

6. Press input rear bearing cup in power divider cover web.

IMPORTANT: During pressing operation when installing input shaft (Step **7**), support power divider cover at rear bearing web to prevent possible damage to web.

7. To install input shaft, place rear bearing cone in cup (mounted in power divider cover). Place helical gear in mounting position. Using a press, install input shaft pressing it through the helical gear splines and into rear bearing cone.

NOTE: The following assembly procedures assume input shaft end play adjustment will be made after cover is installed on carrier (see procedures step 2 through 9, page 4—8).

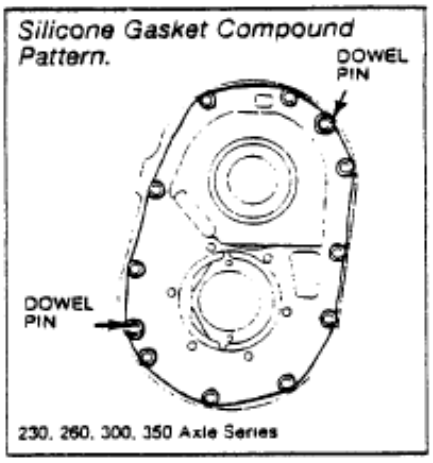
8. For easier adjustment, temporarily install input bearing cover (without shims), cap screws and lockwashers. Tighten screws finger tight.

9. Install bearing spacer, yoke, flat washer and nut. Tighten nut snugly.

10. Make sure power divider cover dowel pins are installed in differential carrier.

11. Apply silicone gasket compound to carrier mating surface (see illustration).

Silicone Gasket Compound Pattern.



12. Install power divider cover, making sure pinion outer support bearing is aligned. Install cap screws and lockwashers.

NOTE: Make sure the one blind cap screw is installed (through output shaft bearing cover opening).

Tighten cap screws to correct torque (see chart, page 4—6).

13. Adjust Input Shaft End Play. Adjust end play and complete the assembly procedure when power divider is assembled to carrier (page 4—8).

Adjust Input Shaft End Play

NOTE: After power divider overhaul and installation in power divider, check and adjust input shaft end play.

Correct end play when new parts are used in overhaul is 0.003" to 0.007", with reused parts 0.013" to 0.017". Refer to Adjustments, Section 3.

Adjust End Play

(by measuring cover clearance and calculating shim pack thickness)

1. Remove input shaft nut, flat washer and yoke. Remove input bearing cover cap screws and lockwashers. Remove bearing cover (and shim pack if installed).

2. Reinstall bearing cover without shims. Hold in position with hand pressure and measure clearance between power divider cover and bearing cover, using a feeler gauge.

3. The bearing cover clearance measured in Step 2 plus 0.005" will equal shim pack thickness required for desired end play (rebuild with new parts). Add 0.015" to shim pack for rebuild with used parts.

4. Install shim pack and bearing cover. Install cap screws and lockwashers. Torque screws to 75-85 ft-lbs. (101-115 N·m).

5. Install yoke, flat washer and nut. Tighten nut snugly. Tap end of input shaft lightly to seat bearings.

6. Check input shaft end play with dial indicator positioned at yoke end of input shaft. Move input shaft axially and measure end play. If end play is correct, seal shim pack to prevent lube leakage then torque input shaft nut and cover cap screws (see chart).

7. If end play is incorrect, change shim pack size, as follows:

Add shims to increase end play.

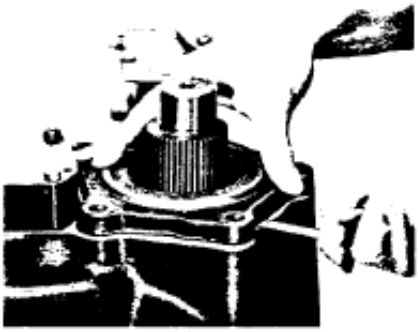
Example:	Desired end play (New Parts)	0.003" to 0.007"
	Measured end play (Step 6)	0.001" — 0.001"
	Add shims to provide desired end play	0.002" to 0.006"

Remove shims to decrease end play.

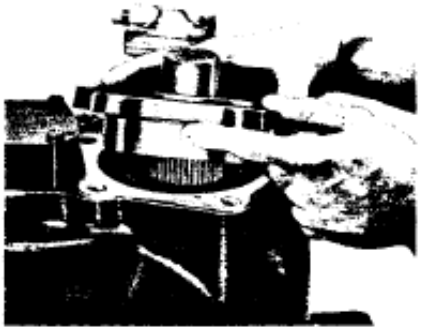
Example:	Measured end play (Step 6)	0.015" — 0.015"
	Desired end play (New Parts)	0.003" to 0.007"
	Remove shims to provide desired end play	0.012" to 0.008"

8. To add or remove shims, remove input shaft nut, flat washer and yoke. Remove cap screws, lockwashers and bearing cover. Add or remove shims as required.

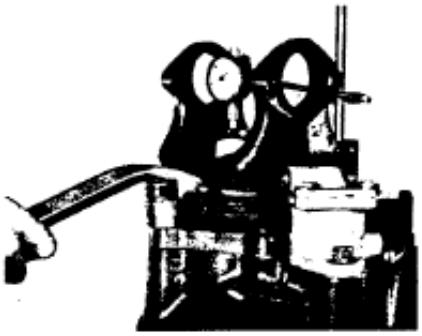
9. Install bearing cover, cap screws and lockwashers. Install oil seal, using a seal driver or suitable sleeve. Install yoke, flat washer and nut. Seal shim pack to prevent lube leakage then torque input shaft nut and cover cap screws (see chart).



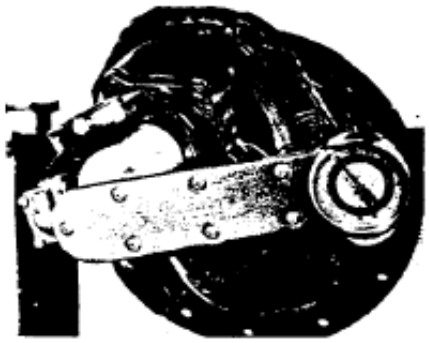
Measuring Bearing Cover Clearance.



Installing Bearing Cover and Shim Pack.



Measuring End Play with Dial Indicator.



Tightening Yoke Nut.

Torque Chart

Input Shaft Nut	Ft-lbs.	N·m
1-5/8-18	780-960	1059-1301
1-7/8-12	840-1020	1139-1383
Bearing Cover Cap Screw		
1/2-13 (Grade 5)	75-85	101-115

NOTE: If difficulty is experienced in achieving correct torque on the input yoke nut, torque the nut with truck on the ground and axle shafts installed.

Adjust Front Output Shaft End Play and Final Assembly of Output Shaft

NOTE: After power divider overhaul and installation on carrier, check and adjust front output shaft end play. Correct end play is 0.003" to 0.007".

Adjust End Play (by measuring cover clearance and calculating shim pack thickness).

NOTE: With output shaft and related parts assembled as described on page 4—3, proceed with step 1.

NOTE: Do not install shift fork, shift unit or oil seal until adjustment is completed.

1. Install output shaft assembly (shaft, gear and bearing cones) in power divider cover. Hold cover in mounting position with hand pressure and measure clearance between the two covers using a feeler gauge. This measured clearance plus 0.005" will equal shim pack thickness required for desired shaft end play.

2. Install the output cover with calculated shim pack. Install the four cover cap screws and lockwashers. Torque cap screws (see chart). Install yoke, flat washers and nut. Tighten nut snugly.

3. Check output shaft end play with dial indicator positioned at yoke end of shaft. If end play is *not* correct, remove cover, yoke and output shaft as an assembly and change shim pack (steps 4 through 7). If end play is correct, proceed to step 8).

Adjust Shim Pack.

4. To increase end play, add shims:

Example: Desired end play	0.003" to 0.007"
Measured end play (Step 3)	0.001" — 0.001"
Add shims to provide desired end play	0.002" to 0.006"

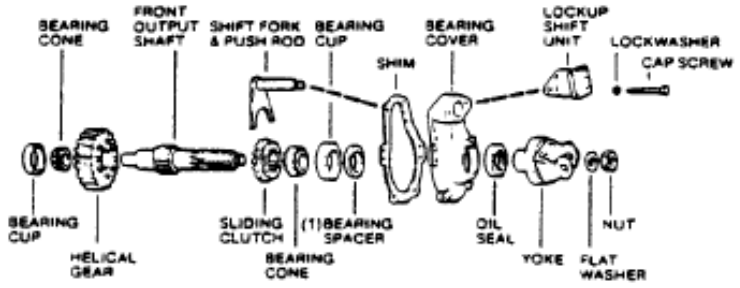
5. To decrease end play, remove shims:

Example: Measured end play	0.015" — 0.015"
Desired end play	0.003" to 0.007"
Remove shims to provide desired end play	0.012" to 0.008"

6. Reassemble adjusted shim pack and output shaft assembly to power divider cover. Install only the four output cover cap screws and lockwashers to recheck end play. Torque cap screws (see chart)

7. Recheck end play with dial indicator. If end play is correct, proceed to Step 8. If incorrect, repeat shim pack adjustment.

Front Output Shaft.



(1) Used only on 185, 220 Series.

Final Shaft Reassembly after End Play Is Correct.

8. IMPORTANT: If oil seal was assembled to cover during adjustments, it could have been damaged. Oil seal replacement is recommended to prevent possible lube leaks.

9. After shaft end play is correctly adjusted, remove the four cover cap screws and lockwashers. Remove output shaft, cover and yoke assembly. Coat mounting surfaces of both output and power divider covers with sealant to prevent lube leakage.

10. Place shift fork in mounting position in cover and on sliding clutch. Then assemble shim pack and output shaft assembly to power divider cover. Install four cap screws and lockwashers fastening output cover but do not tighten cap screws completely.

11. Apply silicone gasket compound to shift unit mounting surface of the output cover (see illustration). Assemble and install shift unit (see Shift System, Section 8). Torque output cover and shift unit mounting cap screws (see chart). To prevent possible lube leakage, coat outer edge of shim pack with sealant.

12. At this point in reassembly, remove yoke and install new oil seal with seal driver. Reinstall yoke, flat washer and nut. Torque nut (see chart).

Torque Chart

Front Output Shaft Cover

Cap Screw	Ft-lbs.	N-m
7/16-14 (two) (Grade 5)	48-56	65-76
9/16-12 (four) (Grade 5)	110-125	149-170

Output Shaft

Nut	Ft-lbs.	N-m
1-1/2-18 (Grade 5)	560-700	759-949

Silicone Gasket Compound Pattern. Lockup Shift Unit.

Single Reduction: 185S4, 220S4, 230S4, 260S4, 300S4, 350S4

Differential Carrier Overhaul

These instructions cover single reduction differential carrier assemblies for 4x4 rear axles. It is assumed that the power divider assembly has been removed from the carrier.

For service information on single reduction carriers equipped with Spicer Controlled Traction Differential, refer to Section 7.

Contents — **Section 5, Page No.**

DIFFERENTIAL CARRIER OVERHAUL

Exploded View 2
Disassemble Differential Carrier 3
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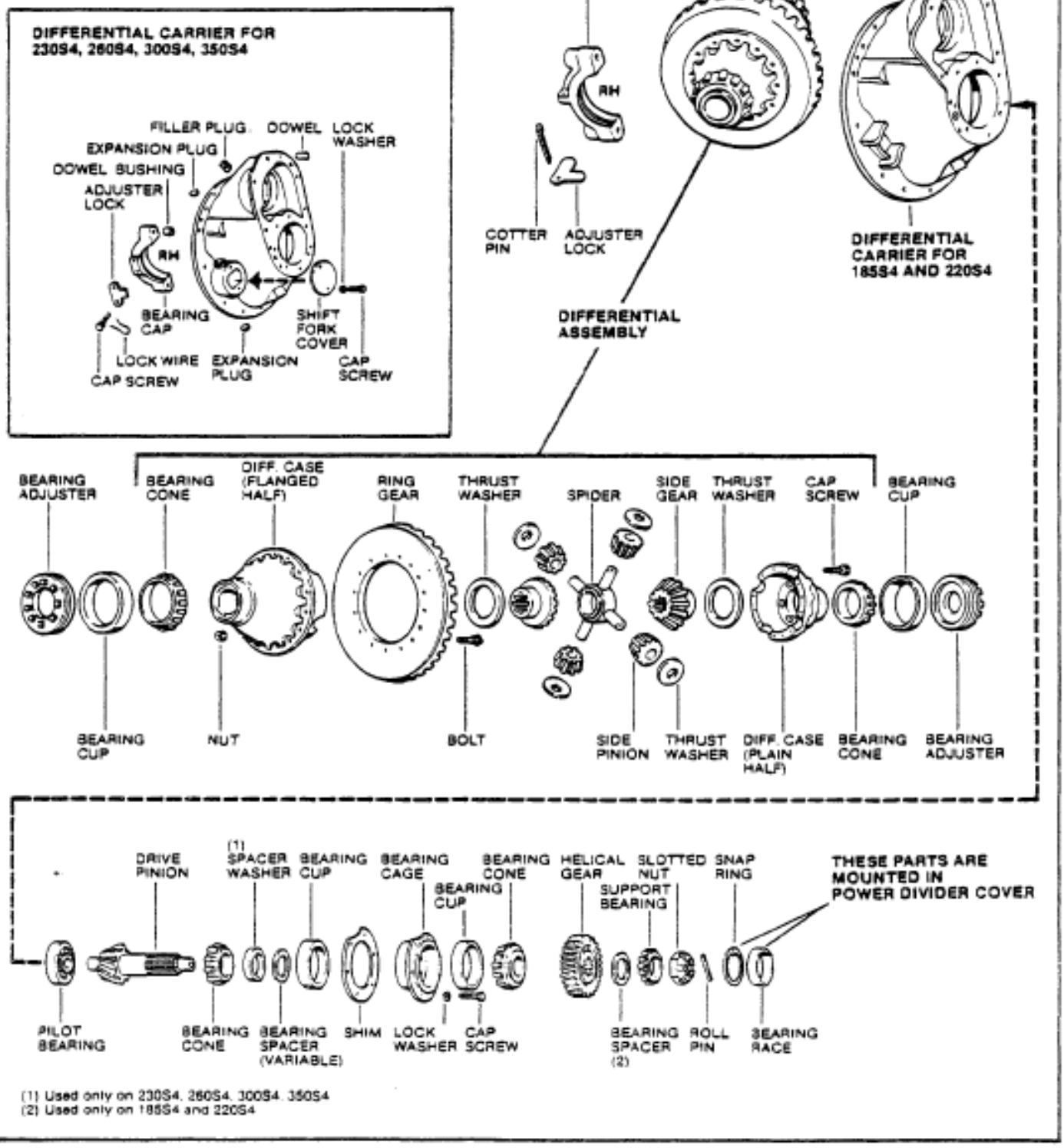
Disassemble Wheel Differential 5
Assemble Wheel Differential 6
Assemble Drive Pinion 7
Install Drive Pinion 9
Install Pinion Outer Support Bearing Race 9
Install Pinion Helical Gear 10
Install Differential Assembly in Carrier 11
Adjust Differential Bearing Preload 13

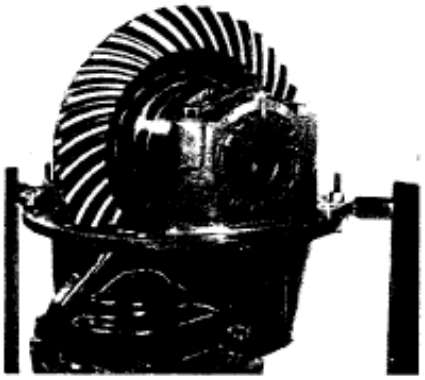
Differential Carrier Assembly 4x4 Rear Axle



(1) Used only on 230S4, 260S4, 300S4, 350S4
(2) Used only on 185S4 and 220S4

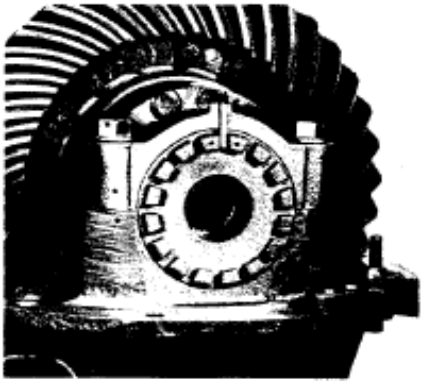
Disassemble Differential Carrier *(with power divider removed)*

NOTE: If gear set is to be reused, check tooth contact pattern and ring gear backlash before disassembling differential carrier. Best results are obtained when established wear patterns are maintained in using gearing. Omit this step if the gear set is to be replaced.



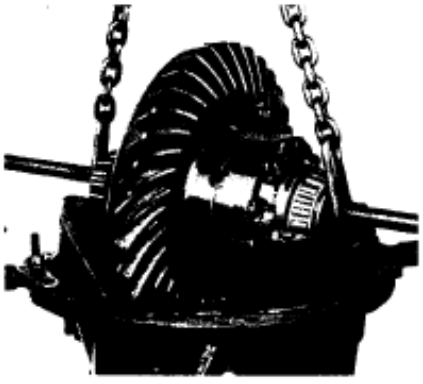
1. Mount the differential carrier in repair stand.

NOTE: For easier disassembly, remove pinion nut roll pin. Loosen but do not remove pinion nut.

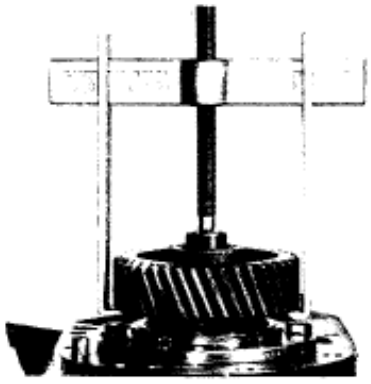


2. Punch mark differential bearing caps. If reusing gear set, also punch mark bearing adjusters for reference during assembly.

3. Cut lockwire. Remove cap screws, flat washers and bearing caps.



4. Using a chain hoist, lift ring gear and differential assembly out of carrier.



5. Forward Axle: Remove pinion nut (see Note under Step 1). Remove bearing and helical drive gear, using puller if necessary.

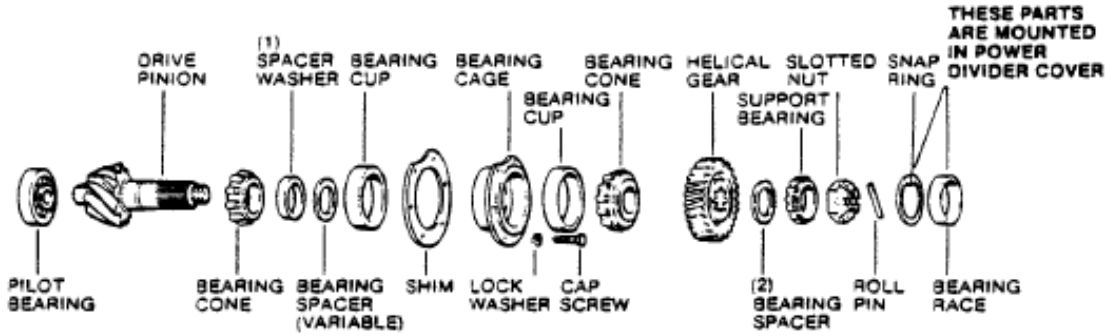
NOTE: (Axle Series 185, 220 only): These models use a spacer between bearing and gear.

6. Forward Axle: Remove pinion bearing cage cap screws. Remove drive pinion and cage assembly from carrier. Remove shim pack.

IMPORTANT: If gear set is to be reused, keep pinion bearing cage shim pack intact for use in reassembly. If the original shims cannot be reused, record the number and size of shims in the pack.

7. Input Shaft Bearing Cup (only on Axle Series 185, 220): If replacement is necessary, use suitable puller to remove bearing cup from carrier.

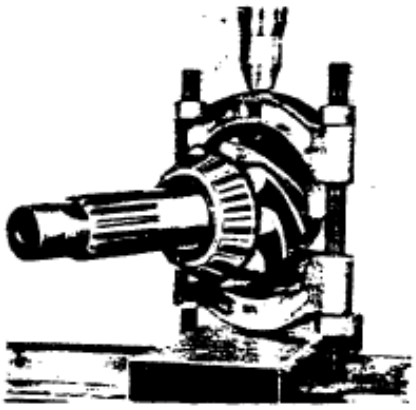
Disassemble Drive Pinion

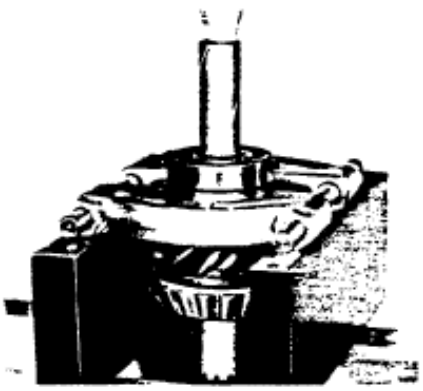


(1) Used only on Axle Series 230, 260, 300, 350.
(2) Used only on Axle Series 185, 220

1. Support pinion bearing cage in press and press pinion out of bearing cage and outer bearing cone.

2. Remove spacer and spacer washer from pinion. Spacer washer is used only on Axle Series 185, 220.





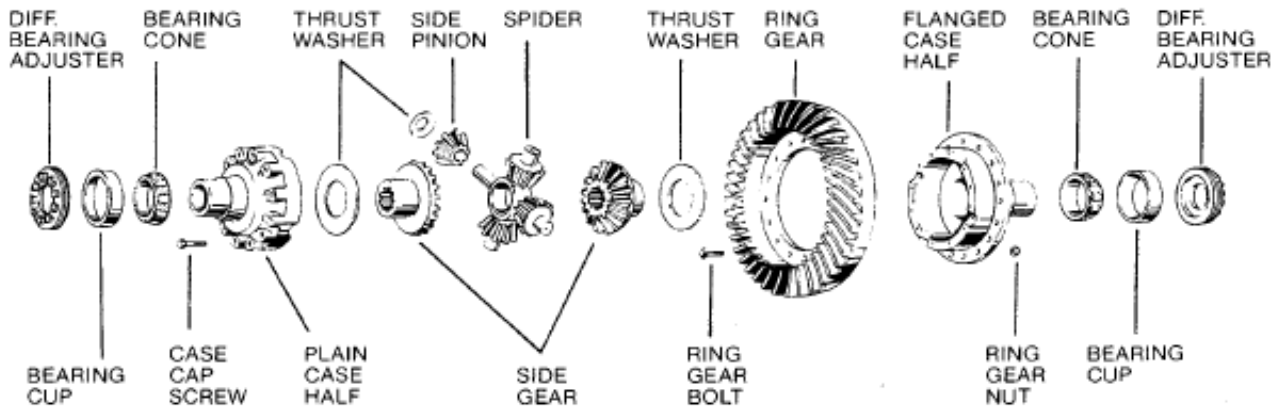
3. Remove pilot bearing and inner bearing cone from pinion, using a split-type puller. Use two procedure steps to remove each bearing (see photos above).

First, mount puller vertically to split the bearing.

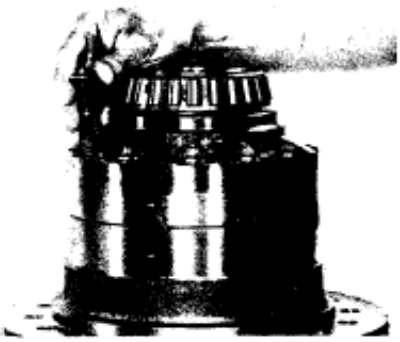
Second, mount puller horizontally to remove bearing.

4. If replacement is necessary, remove bearing cups from bearing cage using suitable pullers.

Disassemble Wheel Differential



1. Remove nuts and bolts fastening ring gear to differential cases, allowing gear to fall free. If gear does not fall, tap outer diameter with soft mallet to loosen.



2. Punch mark differential cases for correct location during assembly. Remove cap screws and lift off plain differential case half.

3. Lift out side gear and thrust washer.

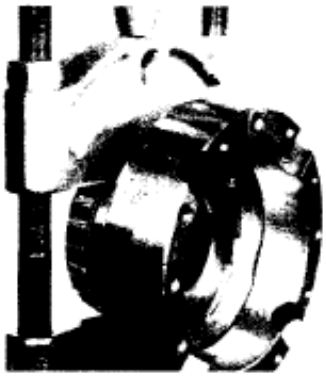
4. Lift out spider, side pinions and thrust washers.

5. Remove side gear and thrust washer.

6. Remove bearing cones from case halves using suitable puller (see photos).

7. Remove bearing cone from plain case half in two steps: **First,** mount puller vertically to split bearing (see photo). This action will start moving bearing off case. **Second,** mount puller horizontally to remove cone.

8. Remove bearing cone from flanged case half using suitable puller.



Puller Mounted Vertically to Split Bearing.

Removing Bearing Cone from Flanged Case Half.

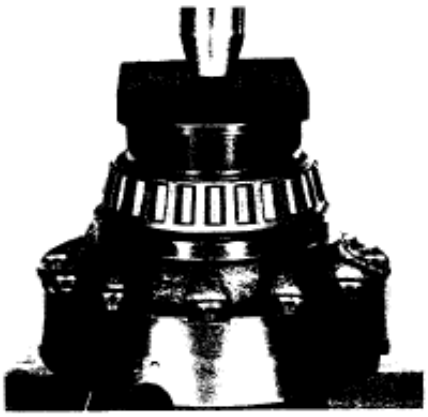
Assemble Wheel Differential

NOTE: Lubricate differential parts with gear lube during reassembly.

1. Press bearing cones on differential case halves (see photos).

IMPORTANT: To prevent bearing damage, use suitable sleeve that only contacts the inner race of the cone.

Press Bearing Cone on Flanged Differential Case.

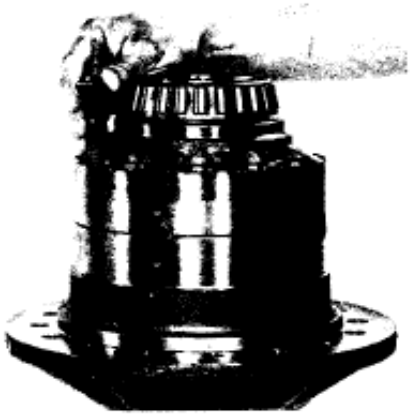


Press Bearing Cone on Plain Differential Case.

2. Place thrust washer and side gear in flanged differential case.

3. Assemble side pinion and thrust washers on spider. Place this assembly in flanged differential case. Rotate gears and check for proper mesh.

4. Place side gear and thrust washer on side pinions.



5. Align punch marks and install plain case half. Install cap screws and tighten to correct torque. Check differential for free rotation by turning side gear hub. Differential may require up to 50 ft-lbs. (68 N·m) torque to rotate.

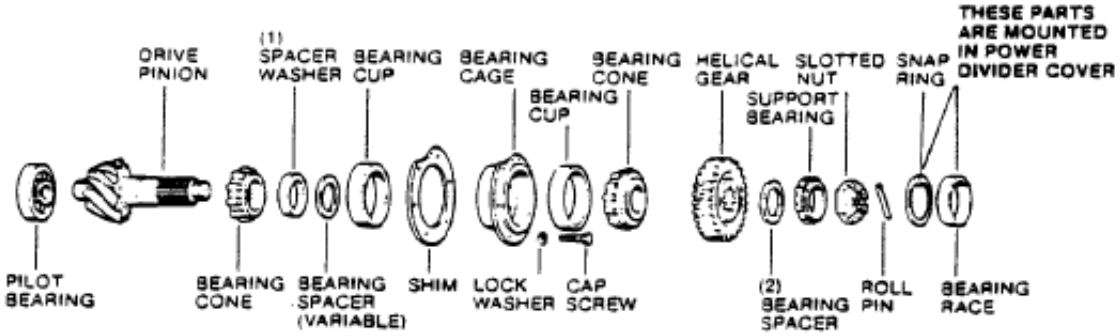
6. Install ring gear. Secure with bolts and nuts. Torque nuts to 180-220 ft-lbs. (244-298 N·m).

Torque Chart

Differential Case Cap Screw

		Ft-lbs.	N·m
1/2-13	Grade 8	90-110	122-149
9/16-12	Grade 8	116-130	157-176
5/8-11	Grade 8	165-195	224-264

Assemble Drive Pinion (*"Press-fit" outer pinion bearing*)



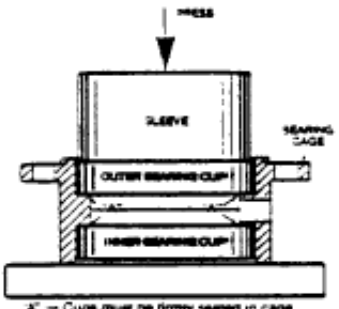
(1) Used only on Axle Series 230, 260, 300, 350.
(2) Used only on Axle Series 185, 220

NOTE: Lubricate parts with gear lube during reassembly.

1. Using appropriate sleeve, press bearing cups in cage (see adjacent drawings).

IMPORTANT: After bearing cups are installed, preselect pinion bearing spacer using the "trial build-up" procedure described in the Adjustments Section of this manual.

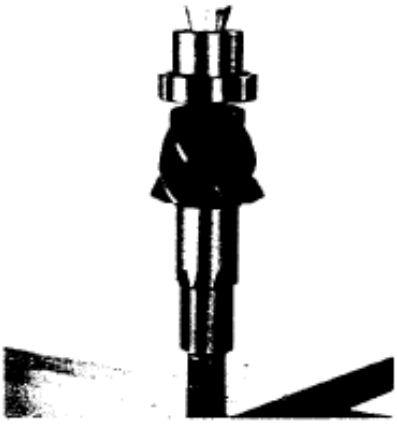
Press Bearing Cups in Cage.



A" — Cups must be firmly seated in cage. Check with feeler gauge (0.001") after installation.

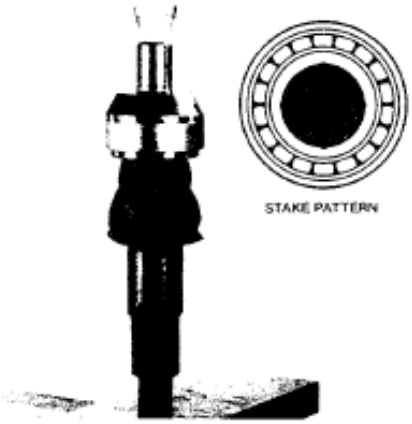
When correctly installed, cups will be recessed below outer surface of cage. Press one cup in at a time.

Assemble Drive Pinion *("Press-fit" outer pinion bearing) (Cont'd)*



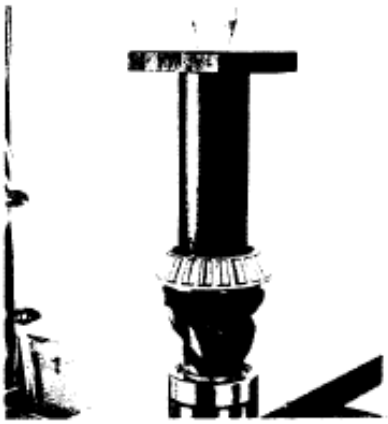
2. Press pilot bearing on pinion

IMPORTANT: To prevent bearing damage, use suitable sleeve that only contacts inner bearing race.



3. Stake pilot bearing using staking tool. This is essential to retain the bearing.

NOTE: During pinion bearing installation, locate each part in same position that was used in "Trial Build-up" Preload Test.



4. Press inner bearing cone on pinion.

IMPORTANT: To prevent bearing damage, use suitable sleeve that only contacts inner race of bearing cone.

5. Install preselected bearing spacer on pinion. Also install spacer washer on Axle Series 220, 230, 260, 300, 350.

6. Install bearing cage on drive pinion.

7. Press outer bearing cone on pinion.

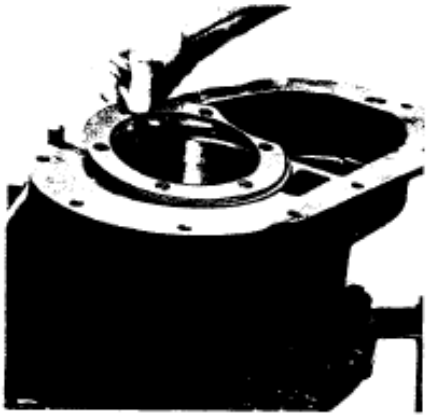
IMPORTANT: To prevent bearing damage, use suitable sleeve that only contacts inner race of bearing cone.

IMPORTANT: At this stage of assembly, "final-check" pinion bearing preload. See Adjustment Section of this manual.

NOTE: After tightening pinion nut, recheck pinion bearing rolling torque. See Adjustment Section for "Press-fit" outer pinion bearing.

8. Pinion Helical Gear and Nut: These parts are installed during pinion installation (see page 5—9 and 5—10).

Install Drive Pinion



1. Place shim pack on carrier.

NOTE: If gear set is to be reused, install same quantity and size of shims removed during disassembly. When installing a new gear set, use nominal shim pack indicated below.

Nominal Shim Pack	
in	**mm**
0.024	0.610

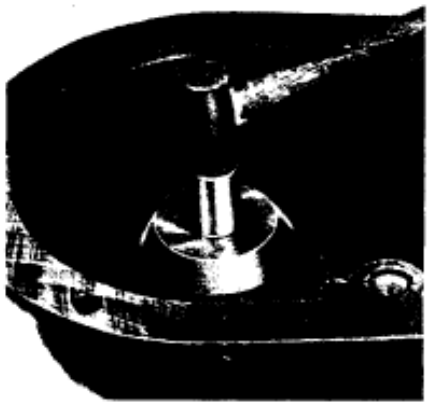
2. Install drive pinion assembly. Install bearing cage cap screws and lockwashers. Torque cap screws to 155-175 ft-lbs. (210-237 N·m).

NOTE: At this phase of reassembly, use a dummy yoke (if available) in place of helical gear. This will result in easier disassembly and reassembly during carrier adjustments.

If dummy yoke is not available, proceed with helical gear installation (see next page).

3. Input Shaft Bearing Cup (only on Axle Series 185 and 220): If removed, install bearing cup in carrier.

Install Pinion Outer Support Bearing Race



1. If removed, install bearing race in power divider cover, using driver and hammer.

2. Install snap ring to secure bearing race.

! **WARNING:** SNAP RING IS SPRING STEEL AND MAY POP OUT. WEAR SAFETY GLASSES WHEN INSTALLING.

Install Pinion Helical Gear (Axle Series 185, 220)

NOTE: After differential adjustment is complete or if dummy yoke was used, remove nut and yoke. Then continue to assemble pinion as follows:

1. Install helical gear on pinion, positioned as shown in the illustration.
2. Install support bearing spacer.
3. Install support bearing using properly sized driver and hammer.
4. Install slotted nut and tighten according to instructions in torque chart.

Torque Chart

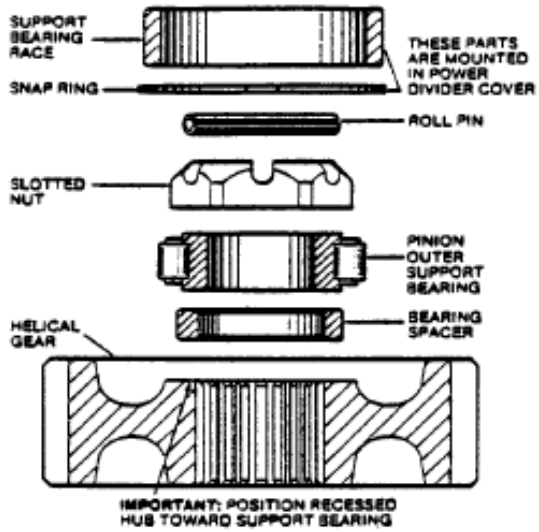
Drive pinion

Slotted Nut and Roll Pin

	Ft-lbs.	N-m
1-1/2-18	840 *	1139 *
1-3/4-12	980 *	1329 *

***IMPORTANT:** Torque nut to torque shown in chart, then continue tightening nut to align slot with nearest hole in pinion shank. Install roll pin.

Pinion Helical Gear and Support Bearing Installation



Install Pinion Helical Gear (Axle Series 230, 260, 300, 350)

NOTE: After differential adjustment is complete or if dummy yoke was used, remove nut and yoke. Then continue to assemble pinion as follows:

1. Install helical gear on pinion using driver and hammer.
2. Install pinion outer support bearing, using driver and hammer.
3. Install slotted nut and tightening according to instructions in torque chart.

Torque Chart

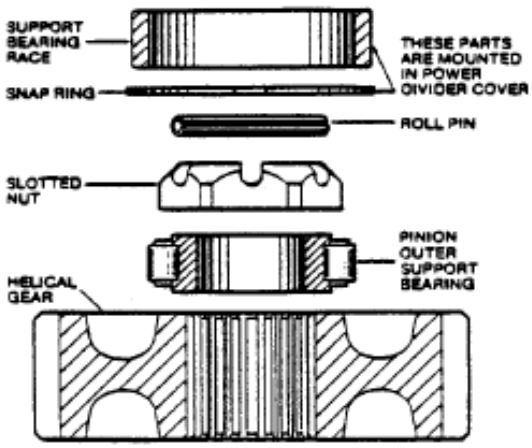
Drive pinion

Slotted Nut and Roll Pin

	Ft-lbs.	N-m
1-1/2-18	840 *	1139 *
1-3/4-12	980 *	1329 *

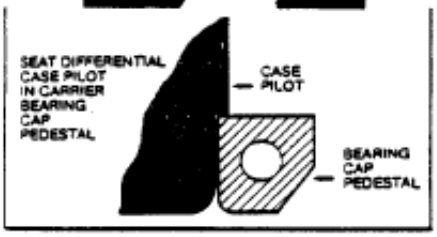
***IMPORTANT:** Torque nut to torque shown in chart, then continue tightening nut to align slot with nearest hole in pinion shank. Install roll pin.

Pinion Helical Gear and Support Bearing Installation



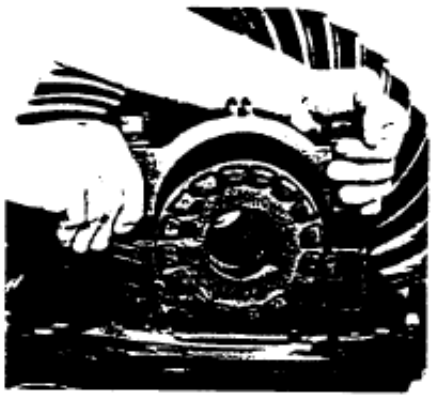
Install Differential Assembly in Carrier *(Axle Series 185, 220)*

NOTE: Lubricate bearings during the following assembly procedures.

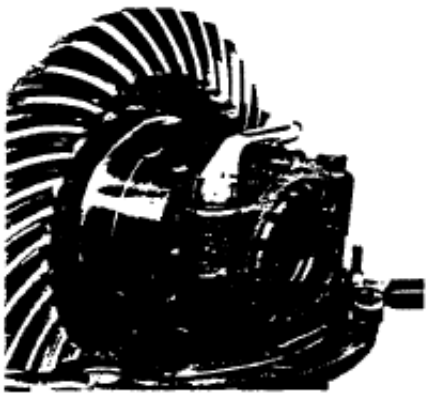


1. Place ring gear and differential assembly in carrier. During installation, tilt carrier to allow differential case pilot to mesh properly with edge of bearing cap pedestal (see photo above).

Install bearing cups at both sides of differential case.



2. Install bearing adjusters and caps.

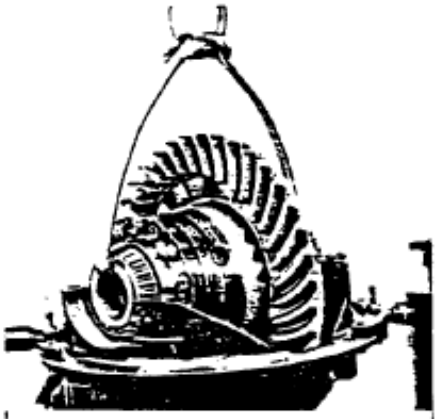


3. Install and tighten bearing cap screws finger-tight. If this is difficult, use hand wrench.

NOTE: Tighten bearing adjuster until its first thread is visible.

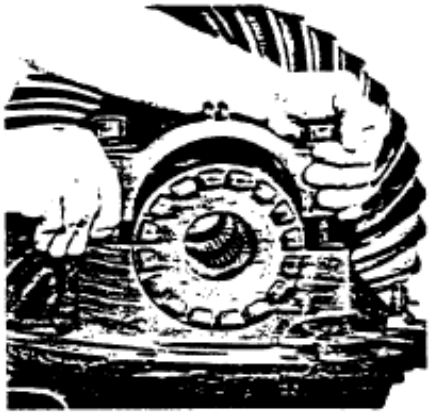
NOTE: With bearing adjusters and caps assembled to carrier, the carrier assembly is now ready for adjustment of bearing preload, ring gear backlash and gear tooth contact (see page 5—13).

Install Differential Assembly in Carrier (Axle Series 230, 260, 300, 350)

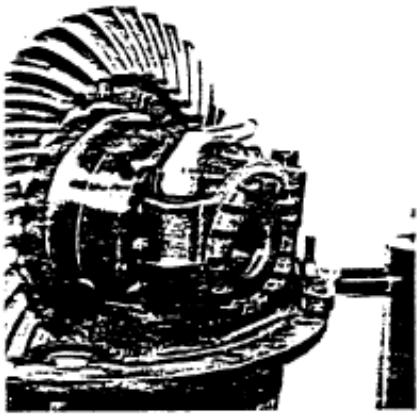


NOTE: Lubricate bearings during the following assembly procedures.

1. Place ring gear and differential assembly in carrier. Carefully lower the assembly until bearing cones rest on carrier.

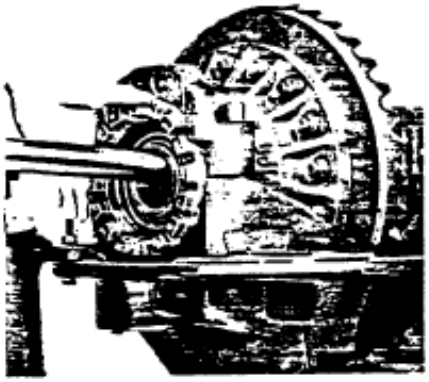


2. At teeth-side of ring gear, install bearing cup, bearing adjuster and bearing cap.



3. Install and tighten bearing cap screws finger-tight. If this is difficult, use hand wrench.

NOTE: Tighten bearing adjuster until its first thread is visible.



4. At back-face side of gear, install bearing cap and cap screws. Tighten cap screws finger-tight. If this is difficult, use hand wrench.

NOTE: If removed, install bearing cup in adjuster, using a press.

Place bar stock through opening in differential. Place bearing adjuster and cup assembly on bar stock (see photo).

Raise and lower differential assembly while threading adjuster into proper position.

NOTE: Make sure adjuster threads are well-lubricated.

NOTE: With bearing adjusters and caps assembled to carrier, the carrier assembly is now ready for adjustment of bearing preload, ring gear backlash and gear tooth contact (see page 5—13).

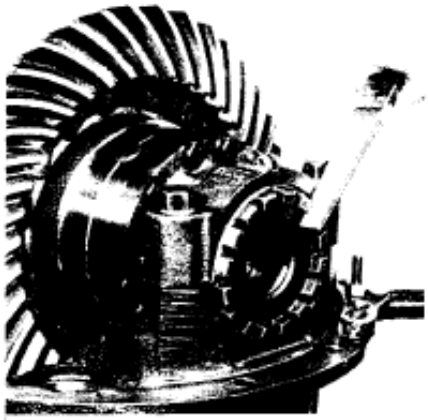
Adjust Differential Bearing Preload:

1. At the teeth-side of ring gear, position bearing adjuster until its first thread is visible.

2. At the back-face side of ring gear, tighten adjuster until there is no backlash.

3. At the teeth-side of ring gear, tighten adjuster until it contacts the bearing cup. Continue tightening adjuster two or three notches. This will preload bearings and provide backlash.

4. Check Ring Gear Backlash. Measure backlash with a dial indicator. Specifications are listed below. Refer to Adjustment Section for detailed instructions on adjusting backlash.



Adjusting Bearing Adjuster

Ring Gear Backlash Specifications

USED GEARING — Reset to backlash recorded before disassembly.
NEW GEARING — Backlash should be as follows:

Axle Series 185, 220 ..... 0.006" to 0.016"
Axle Series 230, 260, 300, 350 ..... 0.008" to 0.018"

5. Check Ring Gear Tooth Contact. Paint ring gear teeth and check tooth contact pattern. Correct tooth patterns are illustrated below. For checking and adjusting procedures, see Adjustment Section.

Checking Ring Gear Backlash

Torque Chart

Diff. Carrier Bearing Cap Screws

		Ft-lbs.	N·m
3/4-10	Grade 8	360-440	488-596
13/16-10	Grade 8	370-430	501-583

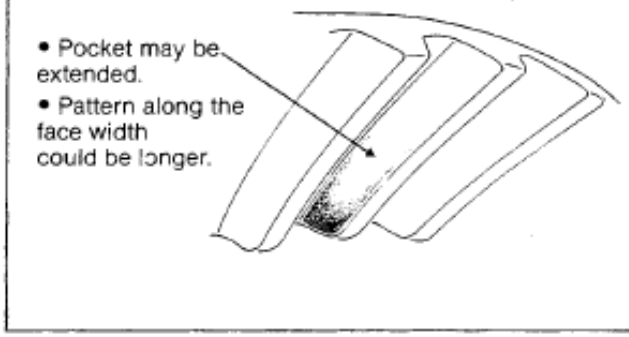
Bearing Adjuster Lock Cap Screws

		Ft-lbs.	N·m
5/8-11	Grade 5	160-176	217-239

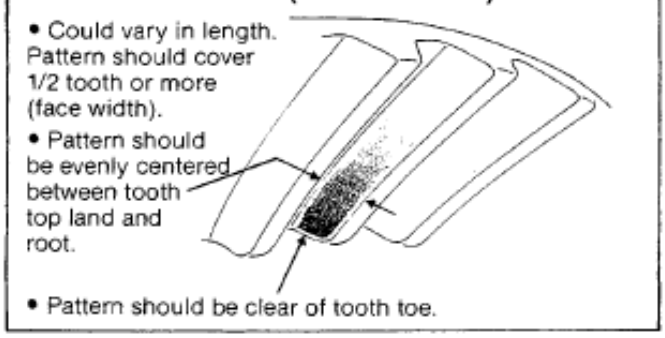
6. With ring gear and pinion adjusted correctly, align adjusters and locks, then tighten differential bearing cap screws to correct torque (see chart, next page). Install cotter pin in one adjuster lock. Install cap screws in opposite adjuster lock and tighten to correct torque (see chart, next page). Lockwire bearing and adjuster lock cap screws.

NOTE: Axle Series 230, 260, 300, 350: On teeth-side of ring gear, install lock and cotter pins. On back-face side of ring gear, install "T" shaped lock and cap screws. Torque screws (see chart) Lockwire all cap screws, both sides of ring gear.

CORRECT PATTERN (USED GEARING)



CORRECT PATTERN (NEW GEARING)


• Could vary in length. Pattern should cover 1/2 tooth or more (face width).
• Pattern should be evenly centered between tooth top land and root.
• Pattern should be clear of tooth toe.

Dual Range: 185T4, 220T4, 230T4, 260T4, 300T4, 350T4
Double Reduction: 185P4, 220P4, 230P4, 260P4, 300P4, 350P4

Differential Carrier Overhaul

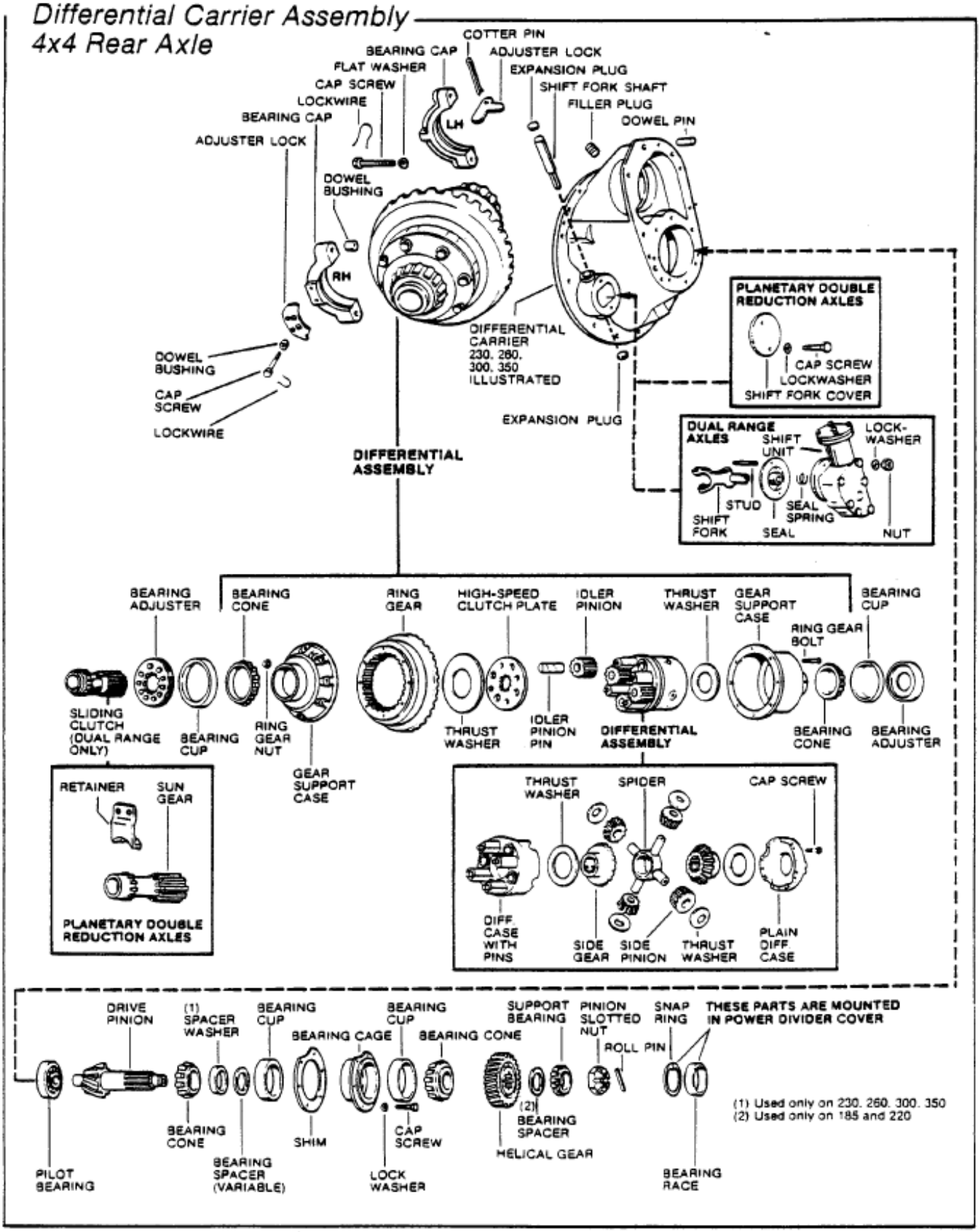
These instructions cover dual range and double reduction differential carrier assemblies for 4x4 rear axles. It is assumed that the power divider assembly has been removed from the carrier.

Contents — **Section 6, Page No.**

DIFFERENTIAL CARRIER OVERHAUL

Exploded View 2
Disassemble Differential Carrier 3
Disassemble Drive Pinion 5
Disassemble Wheel Differential 6
Assemble Wheel Differential 8
Assemble Drive Pinion 10
Install Drive Pinion 12
Install Pinion Outer Support Bearing Race 12
Install Pinion Helical Gear 13
Install Differential Assembly in Carrier 14
Adjust Differential Bearing Preload 15

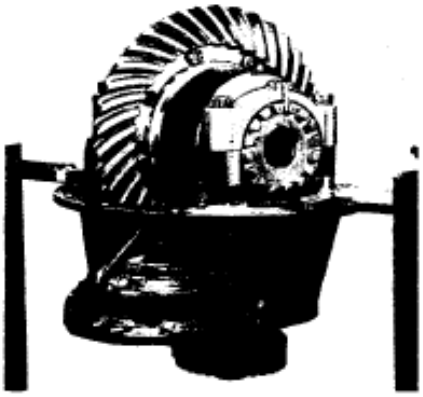
Differential Carrier Assembly 4x4 Rear Axle



Disassemble Differential Carrier *(with power divider removed)*

NOTE: If the gear set is to be reused, check tooth contact pattern and ring gear backlash before beginning disassembly. Best overhaul results are obtained when used gearing is adjusted to run in established wear patterns. Omit this step if the gear set is to be replaced.

When reusing the gear set, remove the left-hand bearing cap, adjuster and lock as a unit. This will help return the gear set to its original adjustment during reassembly.



1. Mount the differential carrier in a repair stand.

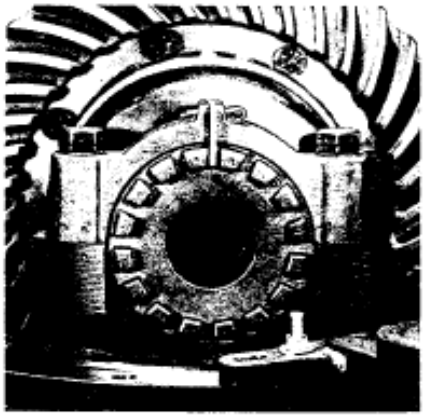
NOTE: For easier disassembly, remove pinion nut roll pin. Loosen but do not remove pinion nut.

2. Dual Range Axles Only: Remove shift fork seal and spring. Remove expansion plugs, then working at the lower (or small) plug hole, drive out the shift fork shaft.

⚠ **WARNING:** WHEN USING A DRIFT, PUNCH OR SIMILAR TOOL, WEAR SAFETY GLASSES.

3. Dual Range Axles Only: Disengage shift fork yoke from sliding collar. Then remove clutch and shift fork.

Planetary Double Reduction Axles: A sun gear is used in place of sliding clutch gear. To remove sun gear, remove cap screws and the retainer which holds gear in position, then remove sun gear.

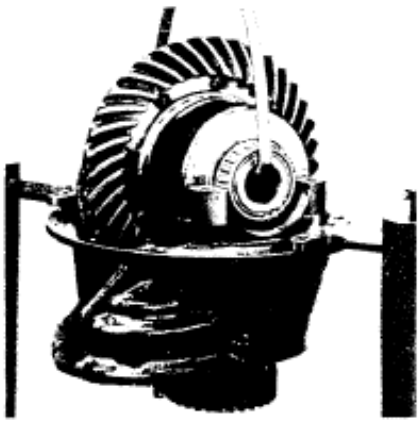


4. If reusing gear set, punch mark bearing adjusters for reference during assembly.

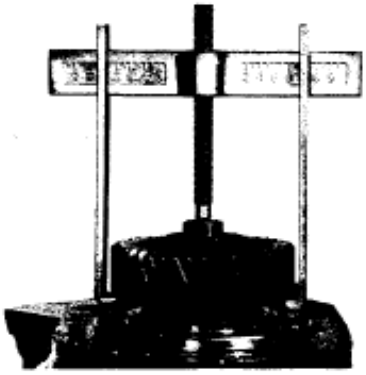
5. On teeth-side of ring gear, cut lockwire and remove bearing cap screws. Remove cap, adjuster and lock.

Disassemble Differential Carrier (Cont'd)

6. On back-side of ring gear, cut lockwire and remove bearing cap screws. If the gear set is to be reused, remove bearing cap, adjuster and lock as an assembly. This will facilitate correct positioning of ring gear during reassembly.



7. Remove bearing cups, then lift ring gear and differential assembly out of carrier.



8. Remove pinion nut (see Note under Step 1). Remove bearing and helical gear using puller if necessary.

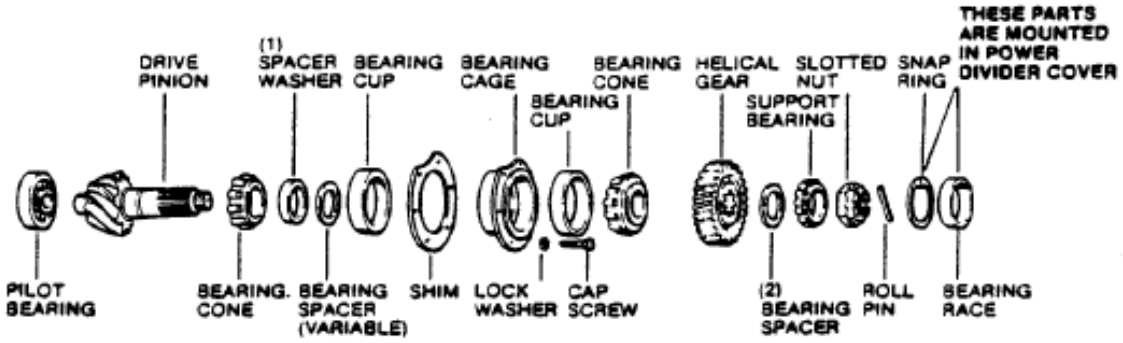
NOTE: (Axle Series 185 and 220): These models use a spacer between support bearing and helical gear.

9. Remove pinion bearing cage cap screws and lockwashers. Remove pinion and cage assembly from carrier. Remove shim pack.

IMPORTANT: If gear set is to be reused, keep pinion bearing cage shim pack intact for use in reassembly. If the original shims cannot be reused, record the number and size of shims in the pack.

10. Input Shaft Bearing Cup (Axle Series 185 and 220): If replacement is necessary, use suitable puller to remove bearing cup from carrier.

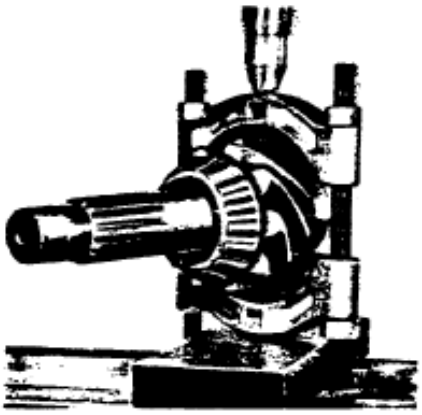
Disassemble Drive Pinion

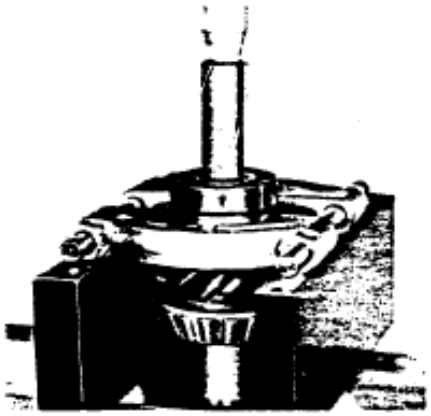


(1) Used only on Axle Series 230, 260, 300, 350.
(2) Used only on Axle Series 185, 220

1. Support pinion bearing cage in press and press pinion out of bearing cage and outer bearing cone.

2. Remove spacer and spacer washer from pinion. Spacer washer is used only on Axle Series 230, 260, 300, 350.





3. Remove pilot bearing and inner bearing cone from pinion, using a split-type puller. Use two procedure steps to remove each bearing (see photos above).

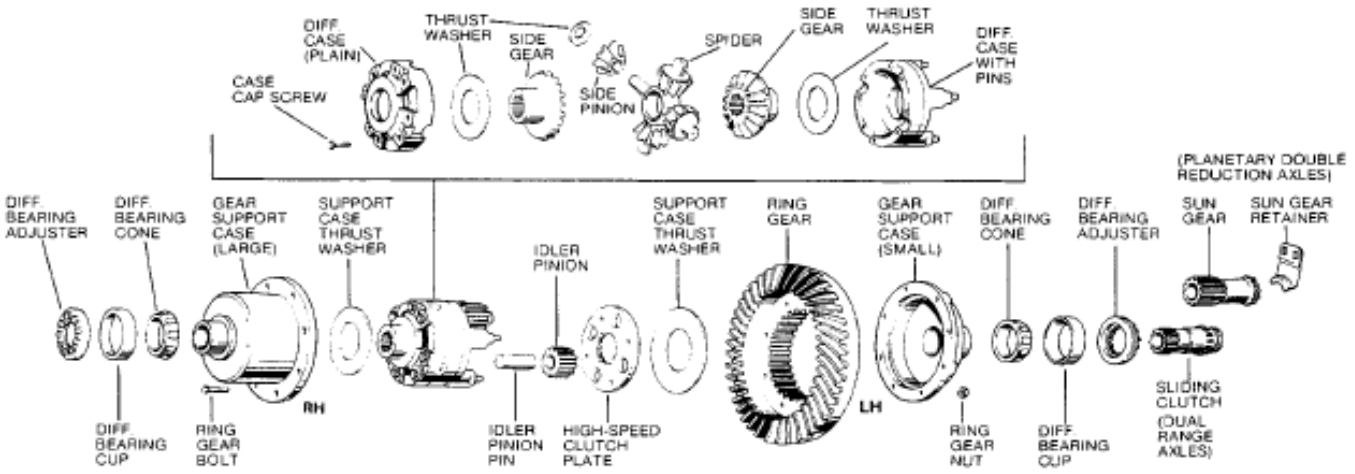
First, mount puller vertically to split the bearing.

Second, mount puller horizontally to remove bearing.

4. If replacement is necessary, remove bearing cups from bearing cage using suitable pullers.

Disassemble Wheel Differential

Rear Axle Wheel Differential Illustrated



1. Remove nuts and bolts fastening ring gear and support cases.

2. Remove small support case and thrust washer.

3. Remove ring gear.

NOTE: A soft-faced hammer or mallet may be required to dislodge gear from its mounting.

4. To remove differential assembly, place support case assembly on a bench or on the floor. Position case on its side, then slowly roll the case and slide differential assembly out of the case.

5. Remove thrust washer from support case.

6. Invert differential assembly to remove idler pins, then remove idler pinions

7. Punch mark differential cases for correct location in reassembly. Remove cap screws and separate case halves.

Disassemble Wheel Differential (Cont'd)

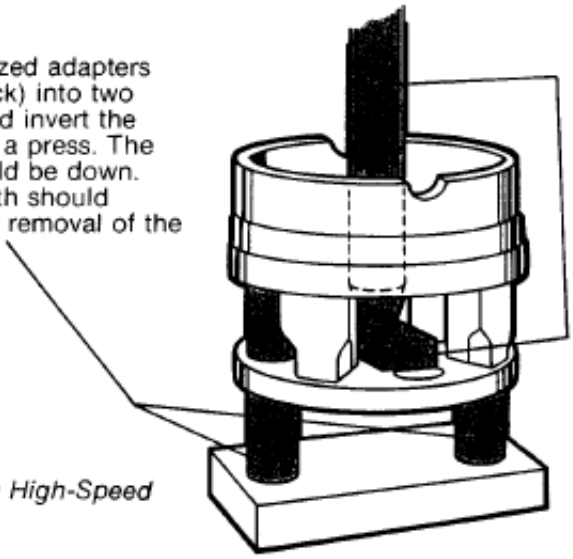
8. Lift out thrust washer and side gear.

9. Lift out spider, side pinions and thrust washers.

10. Remove side gear and thrust washer.

11. First, try to lift off high-speed clutch plate by hand. If it cannot be removed easily, press off plate as follows:

a. Insert properly sized adapters (round metal stock) into two idler pin holes and invert the case assembly in a press. The clutch plate should be down. The adapter length should provide space for removal of the plate.



Setup for Removing High-Speed Clutch Plate

b. Use bar stock to block the center hole in the clutch plate and press against it with the press ram.

c. Continue to press until the plate breaks loose from the plate dowel pins.

12. Remove bearing cones from support cases using suitable puller (see photo).

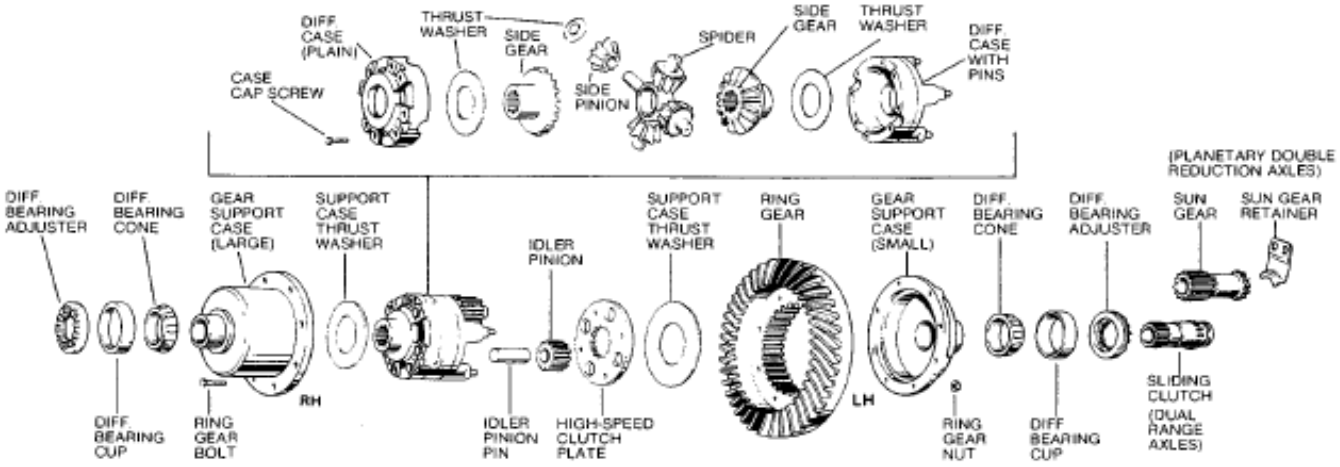
NOTE: Holes are provided in case to enable removal of bearing cone with a pin punch (see photo). Tap alternately through each hole until cone is removed.

WARNING: WHEN USING A DRIFT, PUNCH OR SIMILAR TOOL, WEAR SAFETY GLASSES.

Removing Bearing from Small Support Case using Puller.

Assemble Wheel Differential

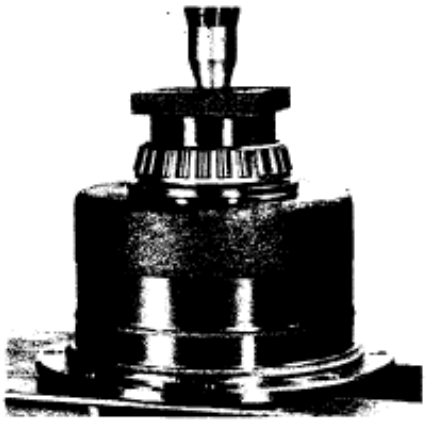
Rear Axle Wheel Differential Illustrated.



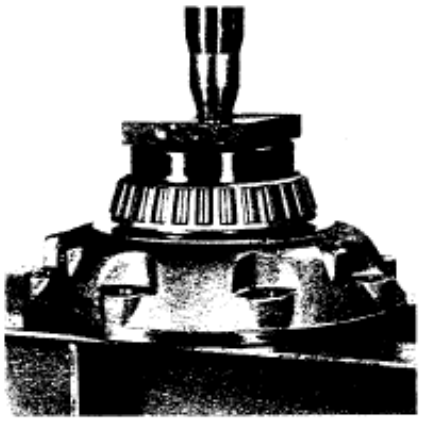
NOTE: Lubricate internal parts with gear lube during reassembly.

1. Press bearing cones on support cases (see photos).

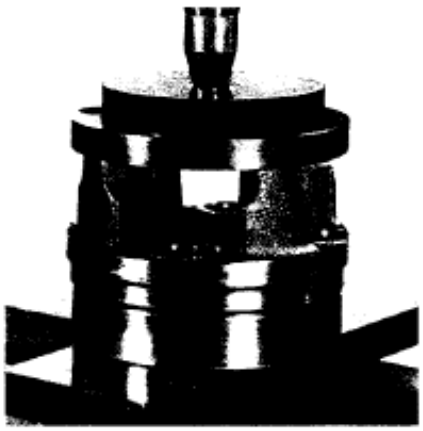
IMPORTANT: To prevent bearing cone damage, use suitable sleeve that only contacts the inner race of the cone.

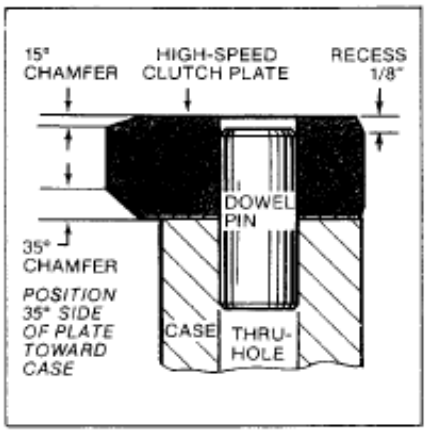


Pressing Bearing Cone on Large Support Case



Pressing Bearing Cone on Small Support Case





2. Position high-speed clutch plate with chamfered end of clutch teeth toward idler pinions. Press clutch plate on case.

IMPORTANT: It is important that the ends of the dowel pins are recessed 1/8" below surface of the clutch plate. If pins extend beyond plate surface, press pins to proper depth. Don't press them in too far.

3. Place thrust washer and side gear in differential case.

Assemble Wheel Differential (Cont'd)

4. Assemble side pinions and thrust washers on spider. Place this assembly in differential case.

5. Place side gear and thrust washer in position on side pinions.

6. Align punch marks and place plain case on case (with pins). Install cap screws and torque (see chart).

NOTE: Turn side gear hub to check for free differential rotation. Rotation may require up to 50 ft-lbs. (65 N·m).

Torque Chart

Differential Case Cap Screw		Ft-lbs.	N·m
1/2-13	Grade 8	90-110	122-149
9/16-12	Grade 8	116-130	157-176

7. Install idler pins and pinions.

8. Place thrust washer in support case.

9. During installation of ring gear, temporarily use two bolts in mounting holes to assure bolt hole alignment. Place ring gear on support case (see photo), then remove the two bolts.

11. Install thrust washer and small support case over differential assembly.

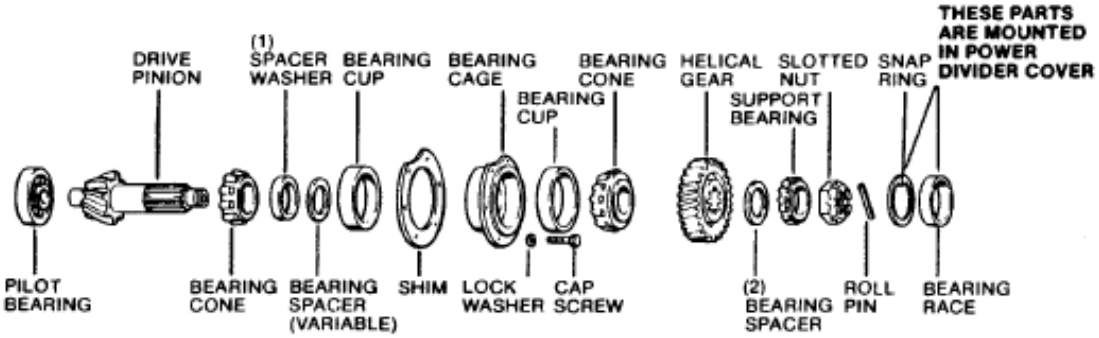
10. To install differential assembly, place support case and ring gear assembly on a bench or the floor. Position case on its side. Carefully lift and slide differential assembly into case. Engage idler pinions with ring gear teeth to complete the installation.

NOTE: During differential installation, be sure thrust washer stays in its proper mounting position.

12. Carefully install ring gear bolts, making certain flat on bolt head is seated against the outside diameter of the support case. Install nuts and torque to 110-130 ft-lbs. (149-176 N·m).

NOTE: Temporarily install sliding clutch (or sun gear) and check planetary for free rotation.

Assemble Drive Pinion *("Press-fit" outer pinion bearing)*



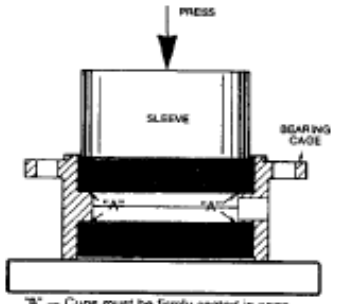
(1) Used only on Axle Series 230, 260, 300, 350.
(2) Used only on Axle Series 185, 220

NOTE: Lubricate parts with gear lube during reassembly.

1. Using appropriate sleeve, press bearing cups in cage (see adjacent drawings).

IMPORTANT: After bearing cups are installed, preselect pinion bearing spacer using the "trial build-up" procedure described in the Adjustments Section of this manual.

Press Bearing Cups in Cage.

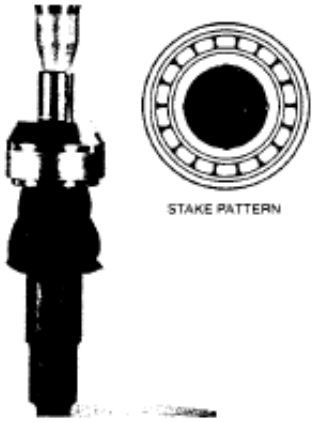


"A" — Cups must be firmly seated in cage. Check with feeler gauge (0.001") after installation.
When correctly installed, cups will be recessed below outer surface of cage. Press one cup in at a time.

Assemble Drive Pinion *("Press-fit" outer pinion bearing) (Cont'd)*

2. Press pilot bearing on pinion

IMPORTANT: To prevent bearing damage, use suitable sleeve that only contacts inner bearing race.



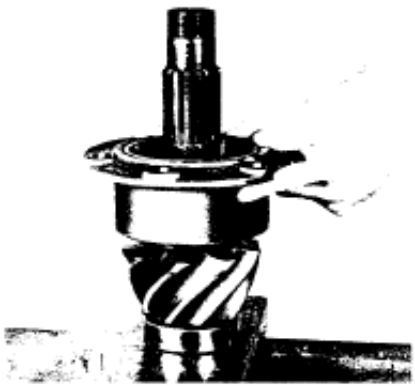
3. Stake pilot bearing using staking tool. This is essential to retain the bearing.

NOTE: During pinion bearing installation, locate each part in same position that was used in "Trial Build-up" Preload Test.

4. Press inner bearing cone on pinion.

IMPORTANT: To prevent bearing damage, use suitable sleeve that only contacts inner race of bearing cone.

5. Install preselected bearing spacer on pinion. Also install spacer washer on Axle Series 220, 230, 260, 300, 350.



6. Install bearing cage on drive pinion.

7. Press outer bearing cone on pinion.

IMPORTANT: To prevent bearing damage, use suitable sleeve that only contacts inner race of bearing cone.

IMPORTANT: At this stage of assembly, "final-check" pinion bearing preload. See Adjustment Section of this manual.

NOTE: After tightening pinion nut, recheck pinion bearing rolling torque. See Adjustment Section for "Press-fit" outer pinion bearing.

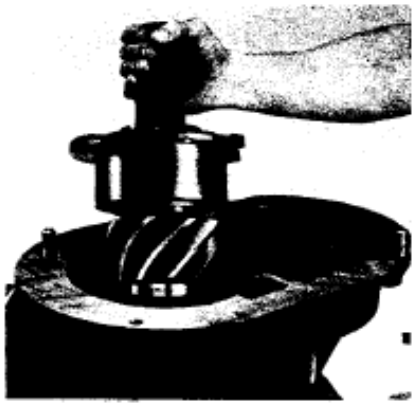
8. Pinion Helical Gear and Nut: These parts are installed during pinion installation (see page 6—12 and 6—13).

Install Drive Pinion

1. Place shim pack on carrier.

NOTE: If gear set is to be reused, install same quantity and size of shims removed during disassembly. When installing a new gear set, use nominal shim pack indicated below.

Nominal Shim Pack	
in	mm
0.024	0.610



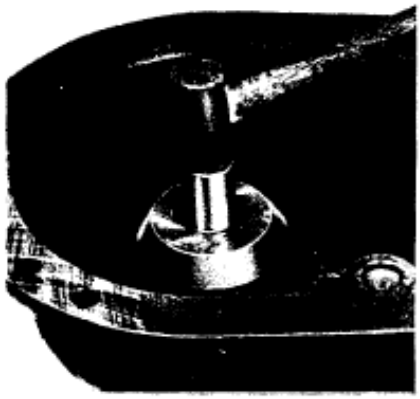
2. Install drive pinion assembly. Install bearing cage cap screws and lockwashers. Torque cap screws to 155-175 ft-lbs. (210-237 N·m).

NOTE: At this phase of reassembly, use a dummy yoke (if available) in place of helical gear. This will result in easier disassembly and reassembly during carrier adjustments.

If dummy yoke is not available, proceed with helical gear installation (see next page).

3. Input Shaft Bearing Cup (only on Axle Series 185 and 220): If removed, install bearing cup in carrier.

Install Pinion Outer Support Bearing Race



1. If removed, install bearing race in power divider cover, using driver and hammer.

2. Install snap ring to secure bearing race.

WARNING: SNAP RING IS SPRING STEEL AND MAY POP OUT. WEAR SAFETY GLASSES WHEN INSTALLING.

Install Pinion Helical Gear *(Axle Series 185, 220)*

NOTE: After differential adjustment is complete or if dummy yoke was used, remove nut and yoke. Then continue to assemble pinion as follows:

1. Install helical gear on pinion, positioned as shown in the illustration.

2. Install support bearing spacer.

3. Install support bearing using properly sized driver and hammer.

4. Install slotted nut and tighten according to instructions in torque chart.

Torque Chart

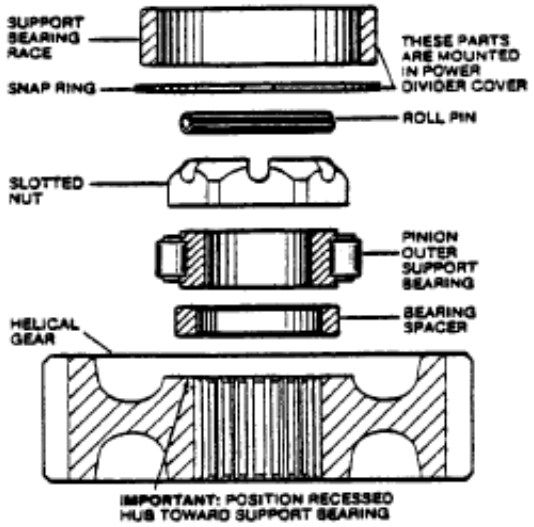
Drive pinion

Slotted Nut and Roll Pin

	Ft-lbs.	N·m
1-1/2-18	840 *	1139 *
1-3/4-12	980 *	1329 *

***IMPORTANT:** Torque nut to torque shown in chart, then continue tightening nut to align slot with nearest hole in pinion shank. Install roll pin.

Pinion Helical Gear and Support Bearing Installation



Install Pinion Helical Gear *(Axle Series 230, 260, 300, 350)*

NOTE: After differential adjustment is complete or if dummy yoke was used, remove nut and yoke. Then continue to assemble pinion as follows:

1. Install helical gear on pinion using driver and hammer.

2. Install pinion outer support bearing, using driver and hammer.

3. Install slotted nut and tightening according to instructions in torque chart.

Torque Chart

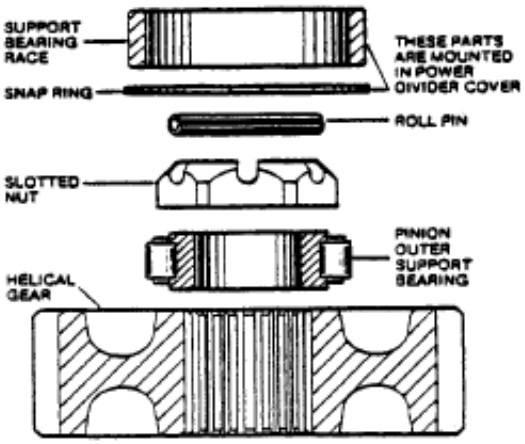
Drive pinion

Slotted Nut and Roll Pin

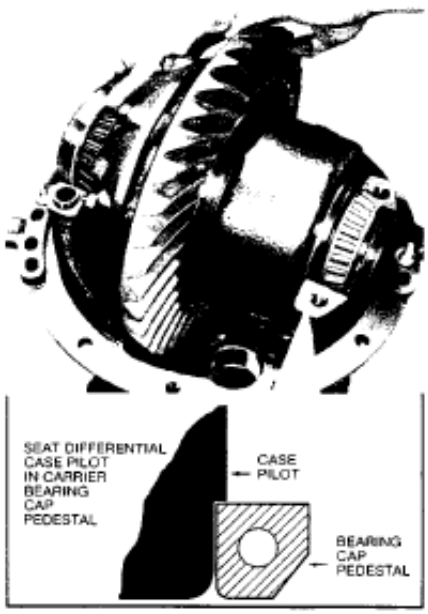
	Ft-lbs.	N·m
1-1/2-18	840 *	1139 *
1-3/4-12	980 *	1329 *

***IMPORTANT:** Torque nut to torque shown in chart, then continue tightening nut to align slot with nearest hole in pinion shank. Install roll pin.

Pinion Helical Gear and Support Bearing Installation



Install Differential Assembly in Carrier



1. Lubricate bearings during the following assembly procedure: Place ring gear and differential assembly in carrier. Insure that ring gear and drive pinion mesh properly.

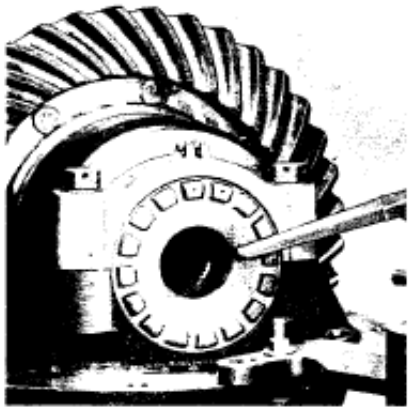
During installation, tilt carrier to allow support case pilot to rest in carrier bore, then install bearing cup as shown in photo. Also install bearing cup on opposite side of differential.

2. If the same gear set is used, install the assembled bearing cap, adjuster and lock on the backface side of the ring gear. Otherwise install adjuster and cap separately.

NOTE: When installing cap, it may be necessary to tap it lightly with a hammer. Be sure cap is fully seated and threads are aligned properly. If trouble is encountered, check for cross-threading of bearing adjuster and carrier threads.

On teeth side of ring gear, install the other adjuster and bearing cap, observing same precautions to avoid cross-threading.

3. Install and tighten bearing cap screws finger-tight. If this is difficult, use hand wrench.



4. At the teeth-side of ring gear, position bearing adjuster until its first thread is visible.

At the back-side of ring gear, tighten adjuster until there is no backlash.

NOTE: With bearing adjusters and caps assembled to carrier, the carrier assembly is now ready for adjustment of bearing preload, ring gear backlash and gear tooth contact (see next page).

Adjust Differential Bearing Preload:

1. At the teeth-side of ring gear, position bearing adjuster until its first thread is visible.

2. At the back-face side of ring gear, tighten adjuster until there is no backlash.

3. At the teeth-side of ring gear, tighten adjuster until it contacts the bearing cup. Continue tightening adjuster two or three notches. This will preload bearings and provide backlash.

4. Check Ring Gear Backlash. Measure backlash with a dial indicator. Specifications are listed below. Refer to Adjustment Section for detailed instructions on adjusting backlash.

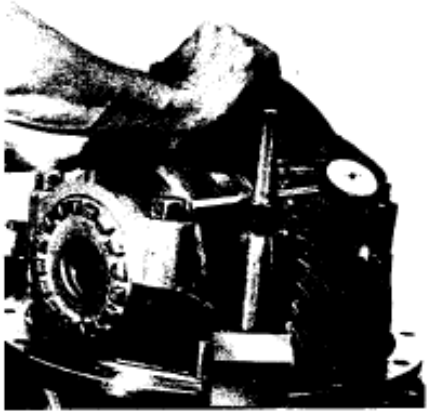
Adjusting Bearing Adjuster.

Ring Gear Backlash Specifications

USED GEARING — Reset to backlash recorded before disassembly.
NEW GEARING — Backlash should be as follows:

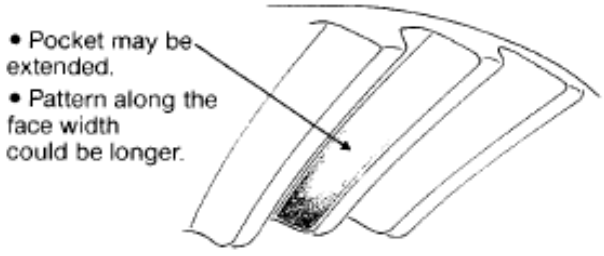
Axle Series 185, 220	**0.006" to 0.016"**
Axle Series 230, 260, 300, 350	**0.008" to 0.018"**

5. Check Ring Gear Tooth Contact. Paint ring gear teeth and check tooth contact pattern. Correct tooth patterns are illustrated below. For checking and adjusting procedures, see Adjustment Section.

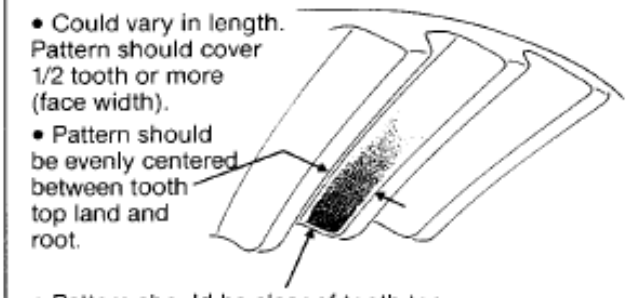


Checking Ring Gear Backlash.

CORRECT PATTERN (USED GEARING)



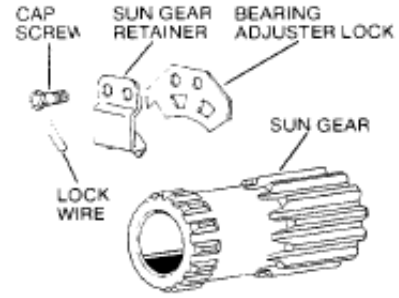
CORRECT PATTERN (NEW GEARING)


• Could vary in length. Pattern should cover 1/2 tooth or more (face width).
• Pattern should be evenly centered between tooth top land and root.
• Pattern should be clear of tooth toe.

6. With ring gear and pinion adjusted correctly, align adjusters and locks, then tighten differential bearing cap screws to correct torque (see chart, next page). Install cotter pin in one adjuster lock. Install cap screws in opposite adjuster lock and tighten to correct torque (see chart, next page). Lockwire bearing and adjuster lock cap screws.

Adjust Differential Bearing Preload (Cont'd)

7. For planetary double reduction axles (on backface side of ring gear), install sun gear and retainer, then install cap screws that fasten both retainer and adjuster lock cap screws. Tighten screws to correct torque (see chart), and lockwire all cap screws.



Planetary Double Reduction Axle

8. For dual range axles: Position shift fork in carrier opening, then install sliding clutch.

9. With clutch installed, engage shift fork yoke with clutch collar. Then install shift fork shaft. Install expansion plugs to seal openings

10. Install shift unit seal and spring.

Installing Shift Fork Shaft.

Torque Chart

Differential Bearing Cap Cap Screw			
Size	**Grade**	**Ft.-lbs.**	**N·m**
13/16-10	(8)	370-430	501-583
Bearing Adjuster Lock and Sun Gear Retainer Cap Screw			
Size	**Grade**	**Ft.-lbs.**	**N·m**
5/8-11	(5)	160-176	217-239

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CTD OVERHAUL

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Remove Differential and Clutch Pack from Carrier 4

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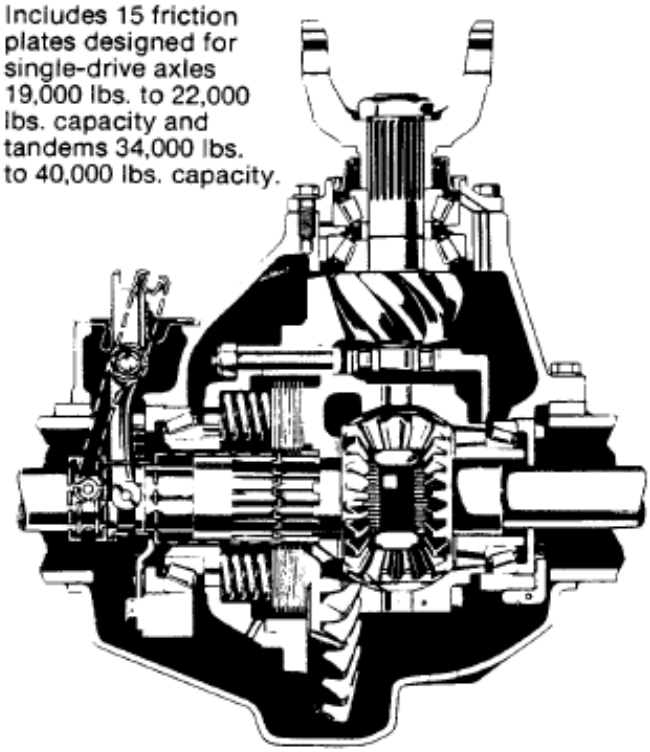
Introduction

Spicer Corporation presents this publication to aid in maintenance and overhaul of Spicer single reduction axles equipped with a biasing-type, controlled traction differential. In this manual, this unit is termed Controlled Traction Differential (or CTD).

Two “design types” are contained in this manual:

Medium-duty CTD.

Includes 15 friction plates designed for single-drive axles 19,000 lbs. to 22,000 lbs. capacity and tandems 34,000 lbs. to 40,000 lbs. capacity.



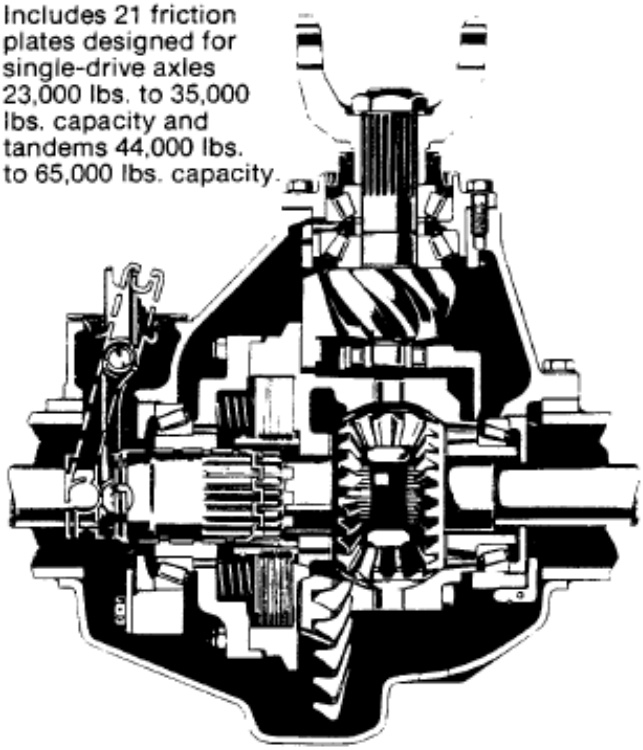
Medium-duty Controlled Traction Differential for:

- Steer-drive Axles ESD-18.
- 4x4 Rear Axles 185S4 and 220S4.
- 6x6 Tandem Axles DS346-P, DS386-P, DS406-P.

(Driver-Controlled Type Illustrated)

Heavy-duty CTD.

Includes 21 friction plates designed for single-drive axles 23,000 lbs. to 35,000 lbs. capacity and tandems 44,000 lbs. to 65,000 lbs. capacity.



Heavy-duty Controlled Traction Differential for:

- 4x4 Rear Axles 230S4, 260S4, 300S4, 350S4.
- 6x6 Tandem Axles DS466-P, DS486-P, DS586-P, DS656-P.

(Driver-Controlled Type Illustrated)

NOTE: In this manual, instructions for both CTD design types are the same except where specified otherwise. This manual includes specific instructions for single reduction, differential carriers (both single drive and tandem axles) equipped with Controlled Traction Differentials. For service instructions covering other axle parts and adjustments, refer to the appropriate Spicer axle service manuals.

Description and Operation

Spicer Controlled Traction Differentials (or CTD) incorporate a friction plate assembly designed to transfer torque from the slipping wheel to the one with traction. Engaged, the Spicer CTD converts to a biasing differential and assists in overcoming adverse operating conditions. Disengaged, it restores conventional differential action for normal road conditions.

The CTD unit is basically a multiple-disc clutch designed to slip above predetermined torque values. This controlled slipping characteristic at higher torque values enables the vehicle to negotiate turns in a normal manner. Resistance to slippage at lower torque values enables the vehicle to maintain an appreciable amount of tractive effort when one wheel encounters relatively poor traction.

The Controlled Traction Differential friction plate assembly (clutch pack) is under constant spring pressure.

The Heavy-duty CTD clutch pack includes tanged and splined friction plates. The tanged plates, attached to the differential case, drive both axle shafts through the splined plates, thereby limiting differential action.

The Medium-duty CTD clutch pack includes internal-splined and external-splined plates. The external-splined plates (engaged with internal teeth of the ring gear) drive the axle shafts through the internal-splined plates, thereby limiting differential action.

In operation, the clutch pack resists spin-out and directs torque to the wheel with better traction.

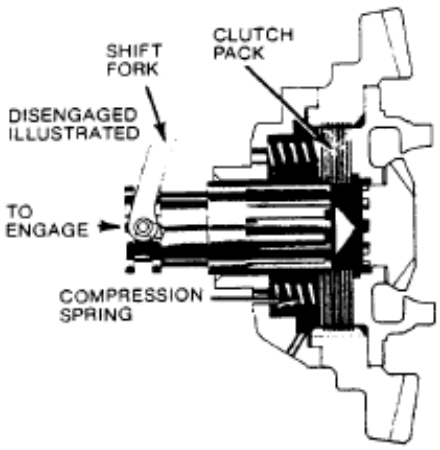
Operating Types

The CTD is available in three operating types:

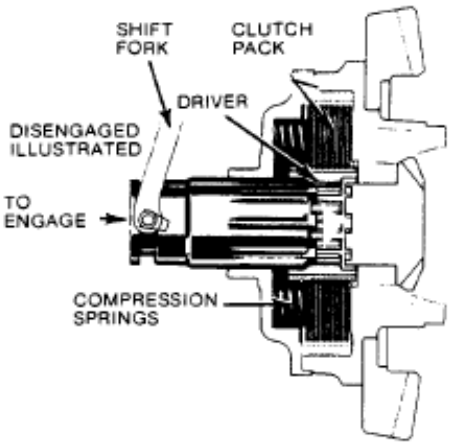
1. Driver-Controlled CTD. Engagement is controlled by a cab-mounted air valve using an Eaton straight-air shift system. See Section 8 for description, service and maintenance.

2. Seasonal Engagement. Manual adjustment in the shop.

3. Permanent Engeagement. Constantly engaged.



Medium-Duty CTD with Optional Fork for Seasonal or Driver-Controlled Engagement.



Heavy-Duty CTD with Optional Fork for Seasonal or Driver-Controlled Engagement.

Checking Effectiveness of Controlled Traction Differentials

(to determine friction plate condition)

The bias torque of a new unit will check out at approximately 4,000 ft-lbs. (or higher) for Heavy-duty CTD, 3,000 ft-lbs. (or higher) for Medium-duty CTD. If bias torque value drops to 1,500 ft-lbs. (or less), replace the clutch pack.

Check bias torque values as follows:

a. Disconnect drive shaft at drive pinion.

b. Block one wheel or otherwise restrain vehicle.

c. Jack up other wheel free of the ground.

⚠ **WARNING:** USE JACK STAND AS ADDITIONAL SUPPORT OF VEHICLE TO PREVENT PERSONAL INJURY OR VEHICLE DAMAGE.

d. Using a torque wrench, rotate pinion and note torque reading.

e. Formula: Torque times axle ratio equals bias differential torque.

Remove Differential Carrier Assembly from Axle Housing

IMPORTANT: Detailed procedures for each type, capacity or model axle may vary. For specific service instructions on your axle, refer to the appropriate Spicer service manual. The following instructions are applicable to axles equipped with Controlled Traction Differentials.

1. Driver-Controlled CTD: Remove shift unit nuts and flat washers. Disconnect air line to permit removal of shift unit. Place sliding clutch in the engaged position. (Sliding clutch must be engaged to allow removal of carrier from housing.)

2. Seasonal CTD: Remove nuts and washers from shift fork cover retainer, then remove cover retainer. Place sliding clutch in the engaged position. (Sliding clutch must be engaged to allow removal of carrier from housing.)

3. Permanent CTD: This type CTD is always engaged. No procedure is necessary.

4. All Types CTD: Drain lubricant. Disconnect drive shaft and remove axle shafts. Remove differential carrier to axle housing cap screws and lockwashers or stud nuts. Remove differential carrier.

Remove Differential and Clutch Pack Assembly from Carrier

NOTE: If the gear set is to be reused, check tooth contact pattern and ring gear backlash before beginning disassembly. Best overhaul results are obtained when used gearing is adjusted to run in established wear patterns. Omit this step if the gear set is to be replaced.

When reusing the gear set, remove the left-hand bearing cap, adjuster and lock as a unit. This will help return the gear set to its original adjustment during reassembly.

Removing Shift Fork Shaft

Removing Sliding Clutch

1. Mount the differential carrier in a repair stand.

2. Driver-Controlled and Seasonal CTD Only: Remove shift fork seal and spring. Remove expansion plugs, then working at the lower (or small) plug hole, drive out the shift fork shaft.

⚠ **WARNING:** WHEN USING A DRIFT, PUNCH OR SIMILAR TOOL, WEAR SAFETY GLASSES.

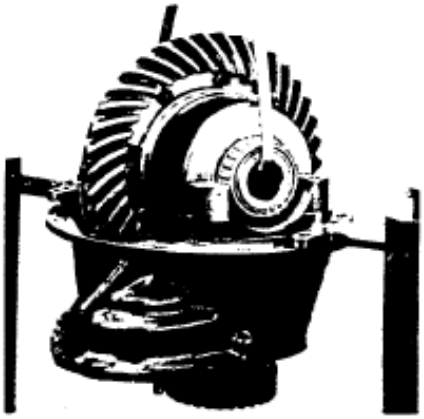
3. Driver-Controlled and Seasonal CTD Only: Disengage shift fork yoke from sliding collar. Then remove clutch and shift fork.

Remove Differential and Clutch Pack Assembly from Carrier (Cont'd)

4. If reusing gear set, punch mark bearing adjusters for reference during assembly.

5. On teeth-side of ring gear, cut lockwire and remove bearing cap screws. Remove cap, adjuster and lock.

6. On back-side of ring gear, cut lockwire and remove bearing cap screws. If the gear set is to be reused, remove bearing cap, adjuster and lock as an assembly. This will facilitate correct positioning of ring gear during reassembly.

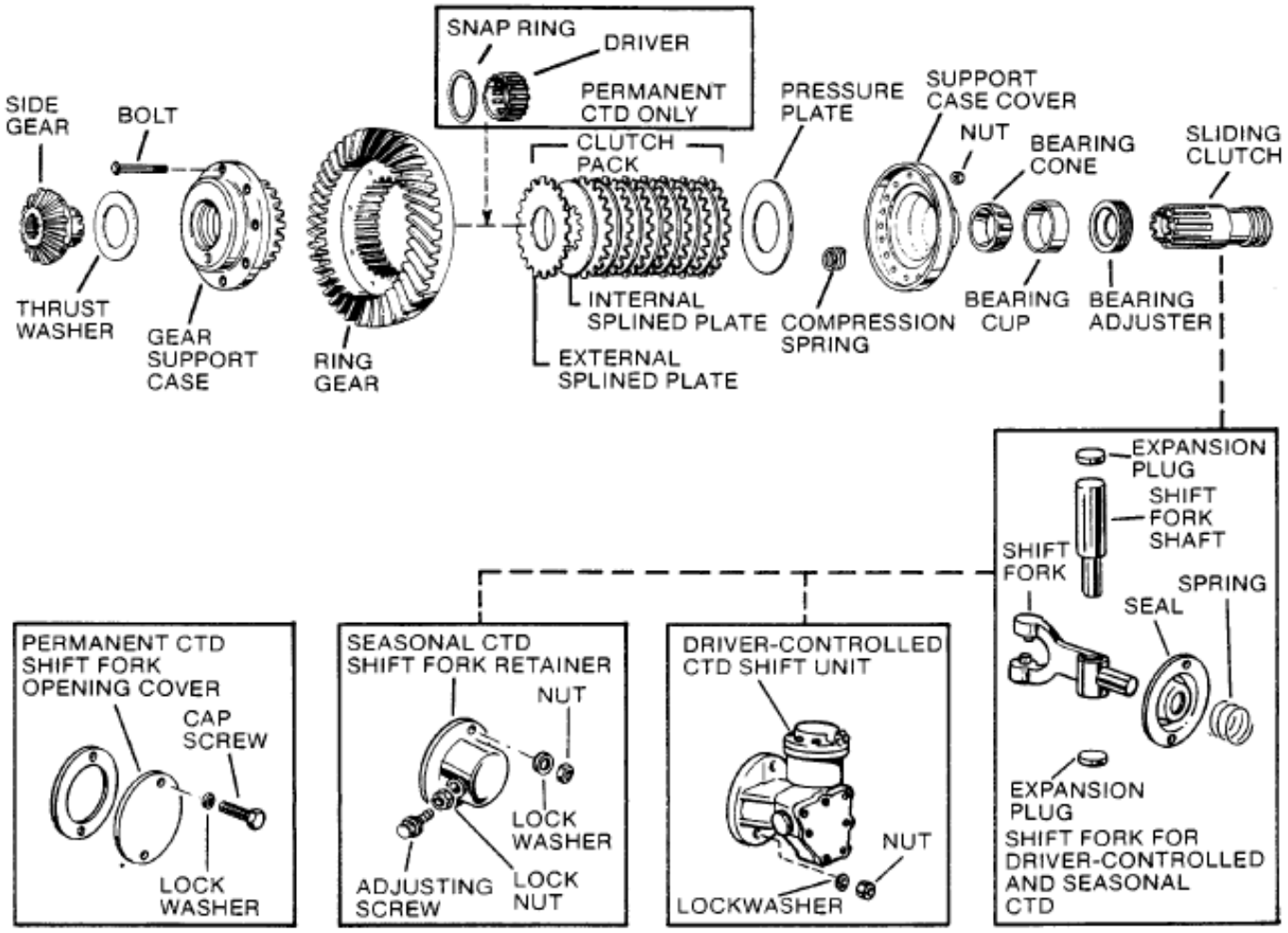


7. Remove bearing cups, then lift ring gear and differential assembly out of carrier.

8. Drive Pinion: For pinion instructions, refer to appropriate Spicer Axle Service Manual covering your specific axle model.

Remove and Disassemble Clutch Pack

Medium-duty CTD Illustrated.



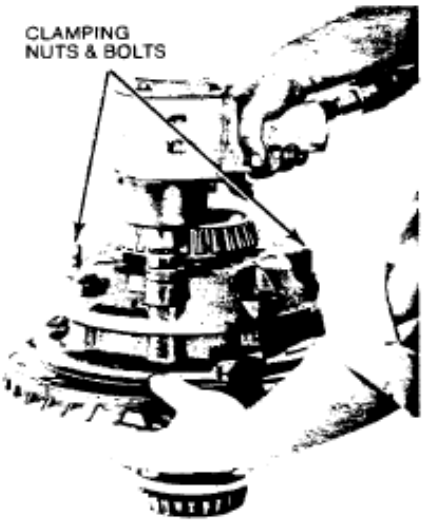
1. Place differential assembly (clutch pack up) on workbench.

⚠ **WARNING:** TAKE PRECAUTIONARY MEASURES TO PREVENT PERSONAL INJURY OR PARTS DAMAGE DURING REMOVAL OF GEAR SUPPORT COVER (Step 2). THE COVER IS UNDER SPRING PRESSURE AND MAY POP OFF WHEN THE LAST LOCKNUT IS REMOVED.

2. Remove two self-locking nuts and bolts (180° apart) fastening support case cover, then temporarily install two clamping bolts and nuts (see photo).

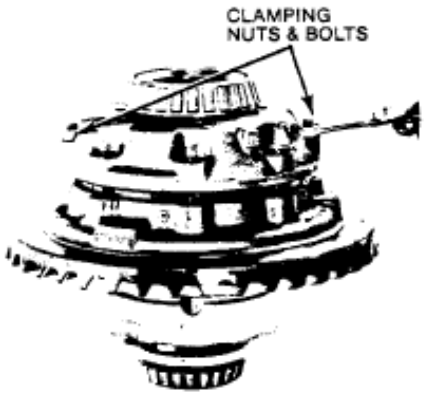
NOTE: These clamping bolts will hold cover in position while removing the other cover self-locking bolts and nuts.

Remove cover self-locking bolts and nuts.



Removing Case Cover (with clamping nuts and bolts installed)

Remove and Disassemble Clutch Pack *(Cont'd)*



Removing Clamping Nuts and Bolts

3. With cover self-locking bolts and nuts removed, alternately loosen and remove the two clamping nuts and bolts.

4. Lift off cover and remove springs.

Removing Support Case Cover

Removing Clutch Pack

5. Driver-Controlled and Seasonal CTDs Only: With cover and springs removed, the pressure plate and clutch pack (friction plates) can be withdrawn or lifted out of ring gear bore. If difficulty is experienced, first remove pressure plate then lift out friction plates individually.

6. Permanent CTDs Only: This type unit includes a driver to engage internal-splined friction plates to the differential side gear. With cover and springs removed, the pressure plate, clutch plate and driver can be withdrawn or lifted out of the ring gear bore. The individual parts can then be separated. The snap ring on the friction plate driver acts as a stop for the plates. Remove snap ring if replacement is necessary.

7. If necessary, the ring gear can be removed from its mounting on the differential and gear support case (flanged case half). If difficulty is encountered, loosen gear by tapping on opposite sides with a soft-nosed hammer.

8. If necessary, remove bearing cone from support case cover using suitable puller.

NOTE: Holes are provided in the cover to enable removal of bearing cone with a punch. Tap alternately through each hole until cone is removed.

9. Inspect Friction Plates. With plates removed, inspect surfaces for deeply scored or burned condition. If a faulty condition is found or if torque check indicates a worn condition (see "Checking Effectiveness of the Controlled Traction Differential," page 7—3), replace the clutch pack.

10. Disassemble and Reassemble Wheel Differential. Refer to the appropriate Spicer Axle Service Manual covering your specific axle.

Assemble and Install Clutch Pack

NOTE: The clutch pack can be installed in differential and gear support case with wheel differential assembled or disassembled. With differential assembled, proceed as follows:

1. All Medium-duty CTD. Place differential assembly on a work bench (clutch pack mounting area up). Install ring gear on support case flange, aligning bolt holes with two temporarily-installed alignment bolts.

Remove alignment bolts.

Installing Clutch Plates Individually (Permanent CTD Only)

Installing Clutch Pack and Driver Assembly (Permanent CTD Only)

2. Install Friction Plates and Driver (Permanent CTD Only).

NOTE: Brush surface of each plate, as it is assembled, with heavy application of axle lube (SAE 90).

NOTE: To assemble friction plates, one of two procedures can be used: Install driver and plates individually (Step 3) or install driver and clutch pack as an assembly (Step 4).

3. Install Friction Plates Individually (Permanent CTD Only).

a. If removed, install snap ring on friction plate driver. Then, install driver assembly (snap ring down) in bore of support case, engaging teeth of differential side gear.

b. Place one external-splined plate in ring gear bore (engaging gear internal teeth). Brush plate with lube.

c. Place one internal-splined plate on driver splines and on top of the external-splined plate. Brush plate with lube.

d. Repeat this procedure until fourteen (14) friction plates (seven internal-splined and seven external-splined) are installed.

e. Install the last external-splined plate and pressure plate. Then install springs and cover (see Step 6).

4. Install Driver and Clutch Pack as an Assembly (Permanent CTD Only).

a. If removed, install snap ring on friction plate driver. Then, place driver (snap ring down) on work bench.

b. Place one external-splined plate on driver. Brush plate with lube.

c. Place one internal-splined plate on top of the external-splined plate. Brush plate with lube.

d. Repeat this procedure until fourteen (14) friction plates (seven external-splined and seven internal-splined) are installed. Then install the last external-splined plate and pressure plate.

e. Rotate external-splined plates as necessary to align the teeth. Then grasp the entire assembly by hand (see photo) and install it in the ring gear.

NOTE: As the assembly is installed, maneuver plates with external splines to align them with the ring gear teeth. Also make sure the driver engages teeth of the differential side gear.

f. Install compression springs and case cover (Step 6).

Assemble and Install Clutch Pack (Cont'd)

5. Install Friction Plates (Driver-Controlled and Seasonal CTD Only).

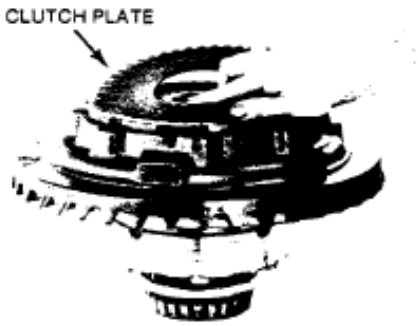
NOTE: During friction plate (internal-splines) installation, align each plate as it is installed in ring gear, using the sliding clutch. If plates are not in alignment, it will be difficult to install sliding clutch, after clutch pack is assembled. Also, as each plate is installed, brush top of plate with a heavy application of axle lube (SAE 90). Proceed as follows:

a. Place one external-splined plate in ring gear bore (engaging gear internal teeth). Brush plate with lube.

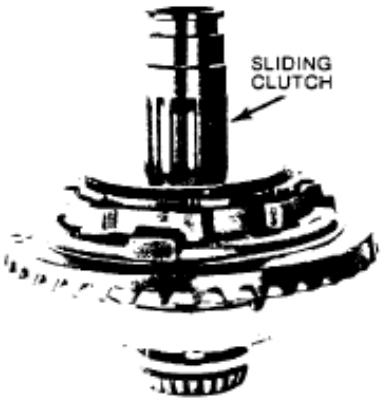
b. Place one internal-splined plate on top of the external-splined plate and brush plate with lube. For alignment purposes, temporarily insert sliding clutch to engage side gear and plate splines. Remove clutch.

c. Repeat this procedure until fourteen (14) friction plates (seven internal-splined and seven external-splined) are installed.

d. Install the last external-splined plate and the pressure plate. And, again, insert sliding clutch to make sure internal-splined plates are in alignment. Install springs and case cover (see Step 6).

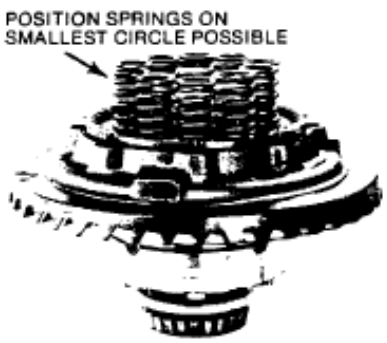


Installing External-Splined Friction Plate



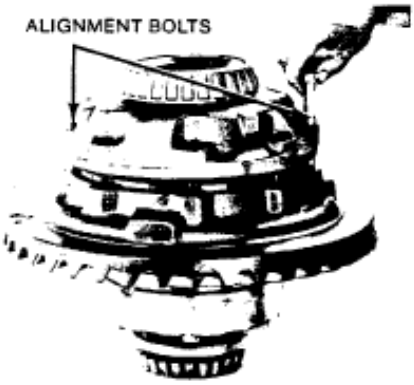
Aligning Internal-Splined Friction Plate with Sliding Clutch

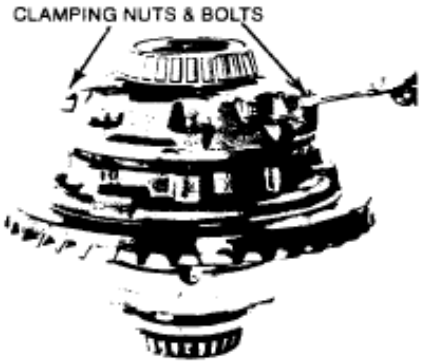
6. Install Compression Springs and Cover (All Types CTD).



a. Install springs on pressure plate, positioning them in the smallest circle possible (see photo).

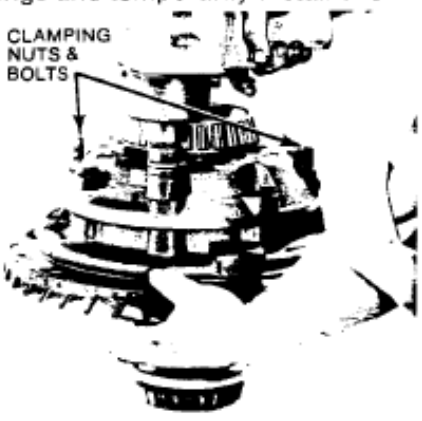
b. Place support case cover over springs and temporarily install two alignment bolts (heads up).





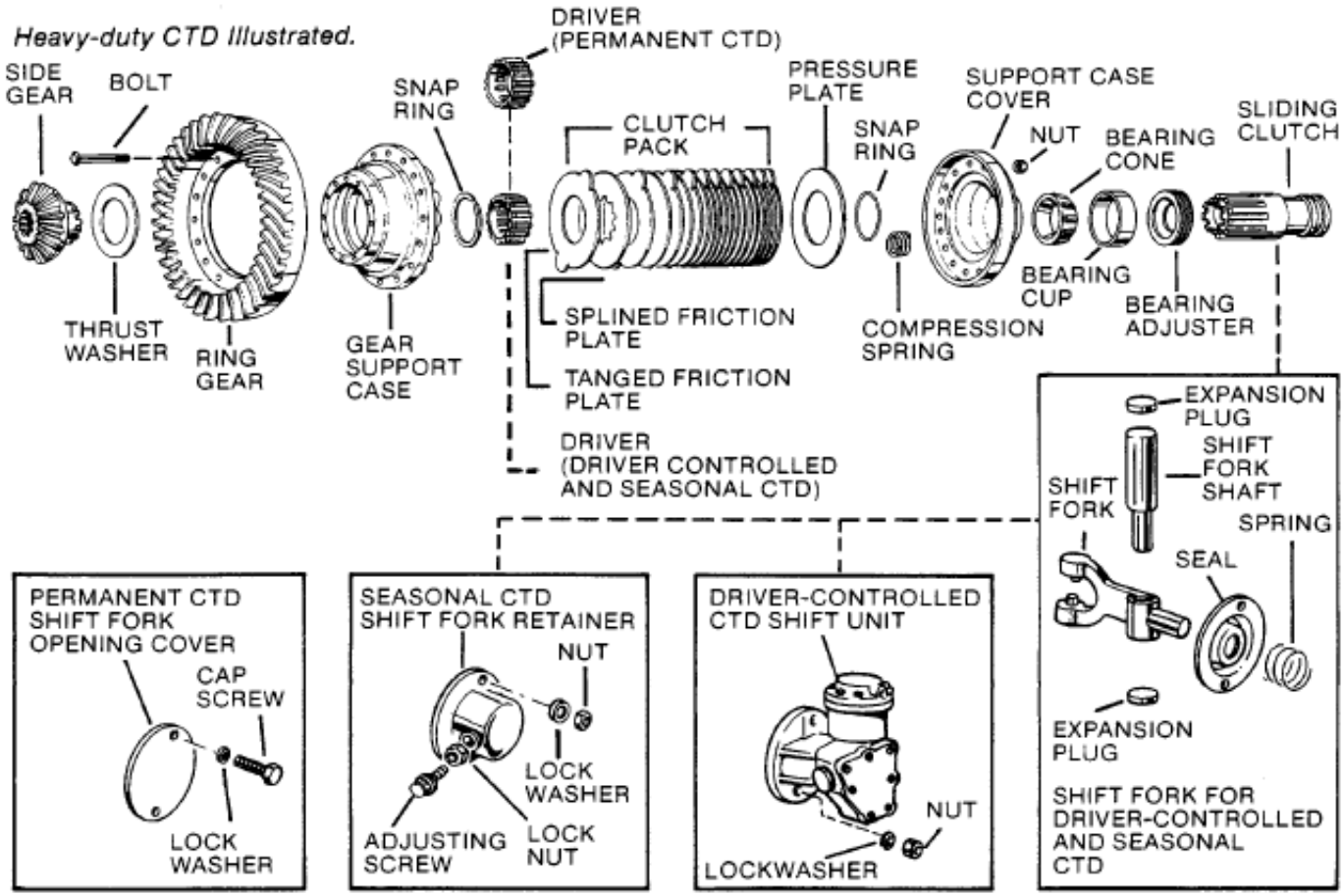
c. Temporarily, install two clamping nuts and bolts (nuts up). Remove alignment bolts. Alternately, tighten clamping nuts until cover is in mounting position on ring gear.

d. Install bolts and self-locking nuts that fasten cover to ring gear. Remove the temporarily-installed clamping nuts and bolts and install the remaining cover bolts and self-locking nuts. Torque nuts to 110-130 ft-lbs. (149-176 N·m).



Remove and Disassemble Clutch Pack

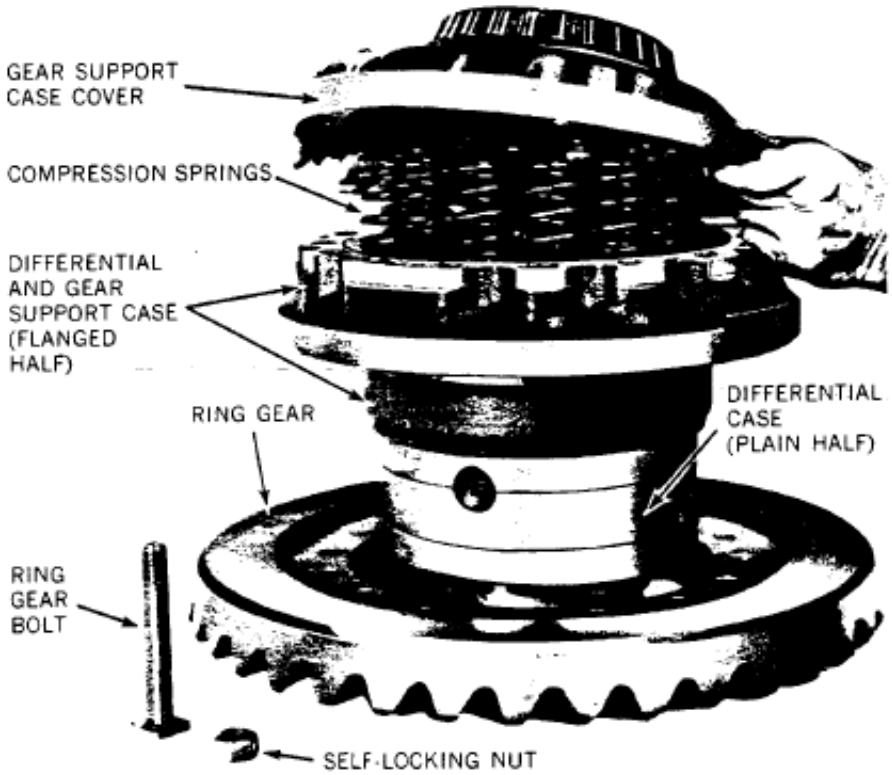
Heavy-duty CTD Illustrated.



1. Place differential and gear support case (clutch pack up) on workbench.

WARNING: EXERCISE CARE DURING DISASSEMBLY PROCEDURE (Step 2 below). THE GEAR SUPPORT CASE COVER IS UNDER SPRING PRESSURE AND THE RING GEAR MAY FALL OFF THE SUPPORT CASE AFTER THE LAST LOCKNUT IS REMOVED. TAKE PRECAUTIONARY MEASURES TO PREVENT PERSONAL INJURY OR PARTS DAMAGE DURING PROCEDURE IN STEP 2, BELOW.

2. Remove self-locking nuts and bolts, then lift off gear support case cover and compression springs.



Removing Gear Support Case Cover

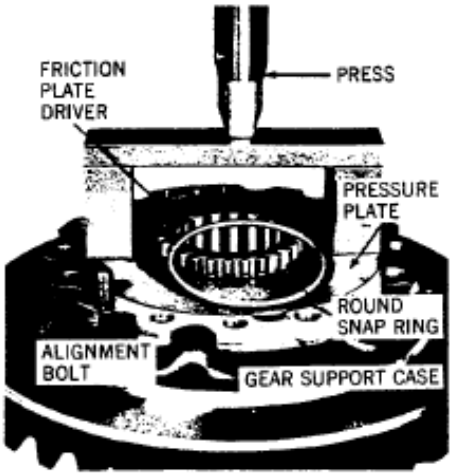
Remove and Disassemble Clutch Pack (Cont'd)

(Heavy-Duty Type)

Removing Clutch Pack

3. Lift up and remove clutch pack assembly from the differential and gear support case (see photo).

4. If ring gear had an interference fit and did not fall off as *previously mentioned in the warning note for Step 2,* tap ring gear alternately on opposite sides with soft-nosed hammer until ring gear is free of gear support case flange.

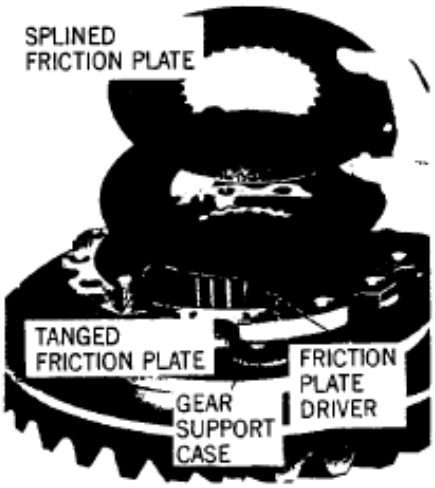


Compressing Clutch Pack in a Press (with clutch pack installed in support case)

5. Disassemble Clutch Pack. To disassemble clutch pack, use a press and suitable adapters.

NOTE: This procedure can be accomplished with clutch pack removed from or installed in support case (see photo).

Compress clutch pack, then remove "round" snap ring. Remove pressure plate, then alternately remove tanged and splined friction plates from friction plate driver.



Removing Tanged and Splined Friction Plates

6. If necessary, remove "rectangular" snap ring from friction plate driver.

7. If necessary to remove bearing cone from differential case cover, place pilot punch in holes provided and tap on bearing cone inner race alternately through each hole until cone is removed.

8. Inspect Friction Plates. With plates removed, inspect surfaces for deeply scored or burned condition. If a faulty condition is found or if torque check indicates a worn condition (see "Checking Effectiveness of the Controlled Traction Differential," page 7—3), replace the clutch pack.

9. Disassemble and Reassemble Wheel Differential. Refer to the appropriate Spicer Axle Service Manual covering your specific axle.

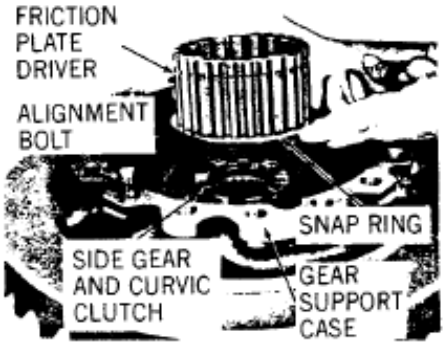
Assemble and Install Clutch Pack

NOTE: The clutch pack can be installed in gear support case with wheel differential assembled or disassembled. With differential assembled, proceed as follows:

NOTE: Ring gear may fit loosely or have an interference fit on the gear support case. Proceed as necessary to assemble ring gear to support case (Step 1 or 2).

1. Install Ring Gear with Interference Fit. Place gear support case assembly on bench with clutch pack side down. Position ring gear (gear teeth up) on gear support case and align bolt holes. Temporarily, install two ring gear bolts to assure alignment, then tap ring gear alternately on opposite sides with a soft-nosed hammer until gear is fully seated against gear support case flange. Turn assembly over, then place in press (gear teeth down) on hard wood blocks. Position blocks to the outside of the ring gear to allow clearance for installation of two alignment bolts. Install alignment bolts, then proceed with reassembly procedures in Step 3.

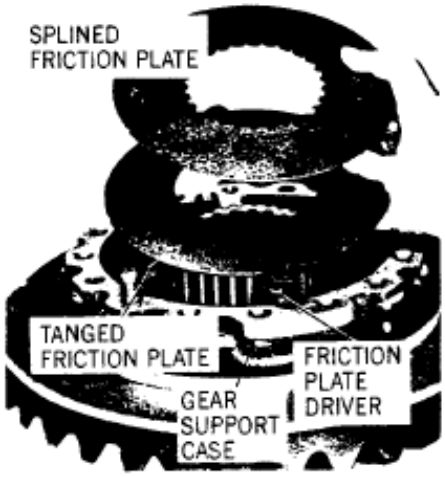
2. Install Ring Gear with Loose Fit. Place ring gear in press (gear teeth down) on hard wood blocks. Position blocks to the outside of the ring gear to allow clearance for installation of the gear support case assembly and two alignment bolts. Place gear support case assembly in ring gear and align bolt holes. Install two alignment bolts in mounting holes, then proceed with reassembly procedures in Step 3.



Installing Friction Plate Driver

3. Install snap ring in square ring groove of friction plate driver. Place friction plate driver (with snap ring down) in center of gear support case.

4. Place one tanged friction plate over friction plate driver, positioning tangs into slots in gear support case (see photo). Brush top of friction plate with a heavy application of axle lube (SAE 90). Place one splined friction plate over friction plate driver and brush top of this plate with lube.



Installing Friction Plates

5. Repeat procedures in Step 4 until there are ten friction plates of each (tanged and splined) mounted on the friction plate driver.

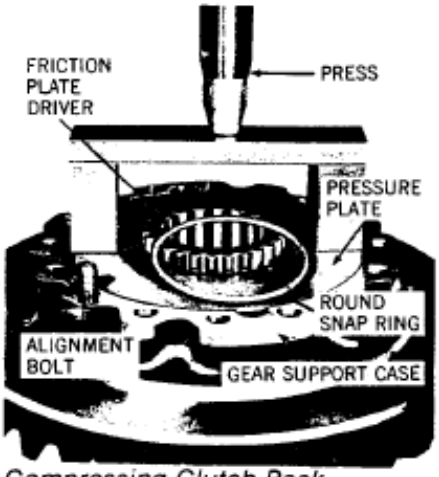
NOTE: Early model CTDs use 25 plates (12 splined, 13 tanged). Late models use 21 plates (10 splined, 11 tanged).

Assemble and Install Clutch Pack (Cont'd)

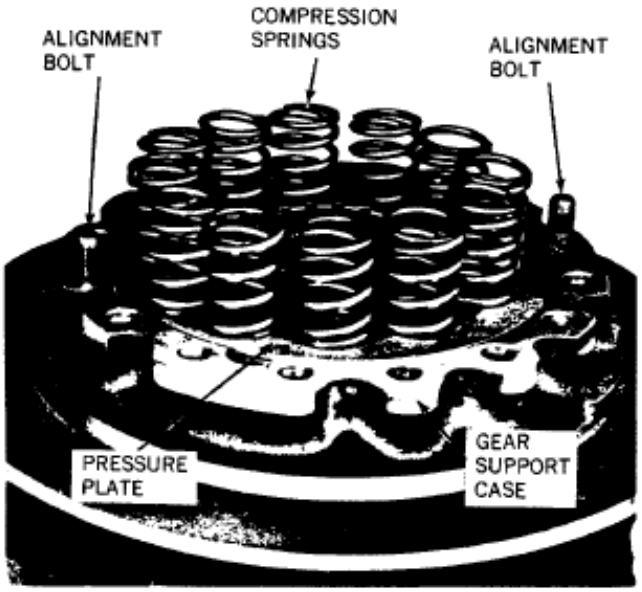
(Heavy-duty CTD)

6. Place last tanged friction plate and pressure plate over friction plate driver. Then using a press and suitable adapters, compress clutch pack and install round snap ring in groove of friction plate driver.

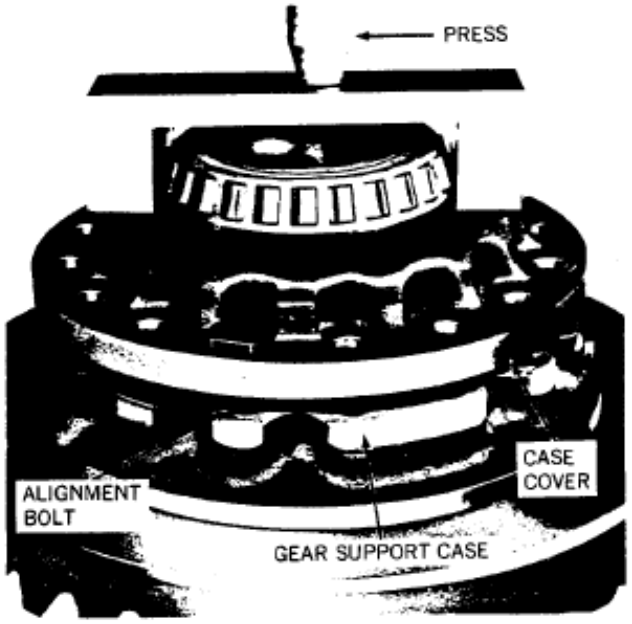
7. If removed, press bearing cone on gear support case cover.



Compressing Clutch Pack in a Press



Positioning Compression Springs on Pressure Plate



Compressing Springs to Assemble Ring Gear, Case and Cover

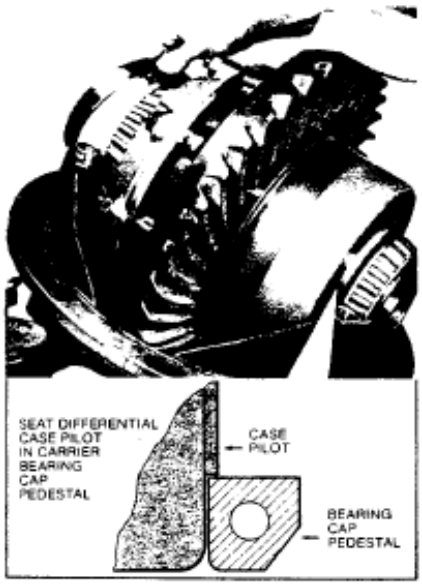
8. Place compression springs in smallest possible circle on pressure plate. Place gear support case cover over springs and temporarily install two alignment bolts. Reach through hole in gear support case cover and move compression springs radially outward as far as they will go.

9. Compress springs until gear case cover bottoms against gear support case. With press pressure still applied, install ring gear bolts (all bolt heads on ring gear side) and locknuts. Remove assembly from press, then tighten locknuts to correct torque (110-130 ft-lbs., 149-176 N·m).

Install Drive Pinion

NOTE: If the drive pinion was removed, refer to the appropriate Spicer Service Manual covering your specific axle for instructions.

Install Differential and Clutch Pack Assembly in Carrier *(All Types CTD)*



NOTE: Lubricate bearings during the following assembly procedure:

1. Place ring gear and differential assembly in carrier. Insure that ring gear and drive pinion mesh properly.

During installation, tilt carrier to allow support case pilot to rest in carrier bore, then install bearing cup as shown in photo. Also install bearing cup on opposite side of differential.

2. If the same gear set is used, install the assembled bearing cap, adjuster and lock on the backface side of the ring gear. Otherwise install adjuster and cap separately.

NOTE: When installing cap, it may be necessary to tap it lightly with a hammer. Be sure cap is fully seated and threads are aligned properly. If trouble is encountered, check for cross-threading of bearing adjuster and carrier threads.

On teeth side of ring gear, install the other adjuster and bearing cap, observing same precautions to avoid cross-threading.

3. Install and tighten bearing cap screws *finger-tight*. If this is difficult, use hand wrench.

NOTE: The assembly is now ready for adjustment of differential bearing preload, ring gear backlash and gear tooth contact.

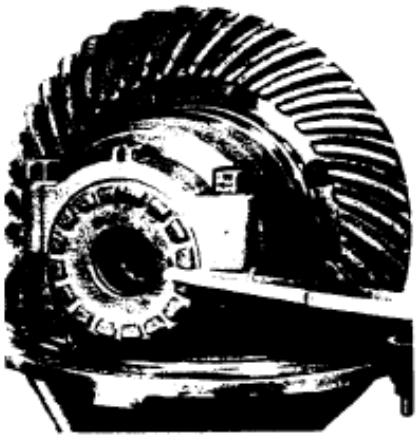
Adjust Differential Bearing Preload:

1. At the teeth-side of ring gear, position bearing adjuster until its first thread is visible.

2. At the back-face side of ring gear, tighten adjuster until there is no backlash.

3. At the teeth-side of ring gear, tighten adjuster until it contacts the bearing cup. Continue tightening adjuster two or three notches. This will preload bearings and provide backlash.

4. Check Ring Gear Backlash. Measure backlash with a dial indicator. Specifications are listed below.



Adjusting Bearing Adjuster

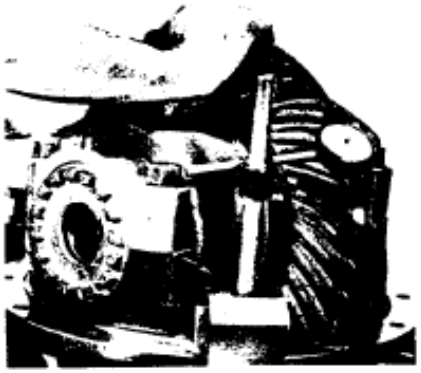
Ring Gear Backlash Specifications

USED GEARING — Reset to backlash recorded before disassembly.
NEW GEARING — Backlash should be as follows:

Axles with 16-1/2" or smaller ring gear diameter	**0.006" to 0.016"**
Axles with 18" ring gears	**0.008" to 0.018"**

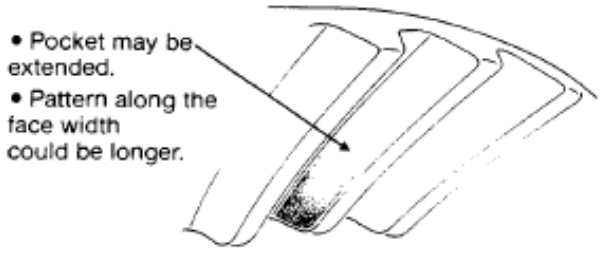
5. Check Ring Gear Tooth Contact. Paint ring gear teeth and check tooth contact pattern. Correct tooth patterns are illustrated below.

NOTE: For detailed instructions on checking and adjusting procedures, refer to the appropriate Spicer Service Manual covering your specific axle.

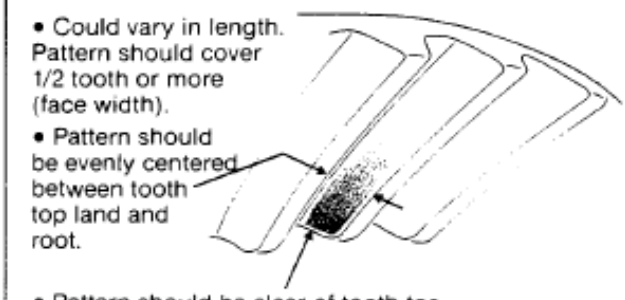


Checking Ring Gear Backlash

CORRECT PATTERN (USED GEARING)



CORRECT PATTERN (NEW GEARING)


• Could vary in length. Pattern should cover 1/2 tooth or more (face width).
• Pattern should be evenly centered between tooth top land and root.
• Pattern should be clear of tooth toe.

6. With ring gear and pinion adjusted correctly, align adjusters and locks, then tighten differential bearing cap screws to correct torque. Install cotter pin in one adjuster lock. Install cap screws in opposite adjuster lock and tighten to correct torque. Lockwire bearing and adjuster lock cap screws.

7. Seasonal and Driver-Controlled CTD Only: Position shift fork in carrier opening, then install sliding clutch. With clutch installed, engage shift fork yoke with clutch collar. Then install shift fork shaft. Install expansion plugs to seal openings. Install shift fork seal and spring over end of shift fork. Move shift fork to place sliding clutch in engaged position. (Sliding clutch must be engaged to allow installation of carrier on housing.)

Install Differential Carrier Assembly in Axle Housing

(All Types CTD)

IMPORTANT: The following instructions cover single drive axles and tandem rear axles. For tandem forward axles (diff. with power divider), refer to the appropriate axle service manual.

IMPORTANT: Before installing carrier assembly, inspect and thoroughly clean interior of axle housing.

NOTE: Use silicone rubber gasket compound on axle housing mating surface as shown in the illustration. Compound will set in 20 minutes. Install carrier before compound sets or reapply.

1. Install differential carrier assembly in axle housing. Install stud nuts and lockwashers. Tighten to correct torque.

2. Install axle shafts and stud nuts. (If used, also install lockwashers and taper dowels.)

3. Connect driveline.

4. Fill axle with correct lube to correct level.

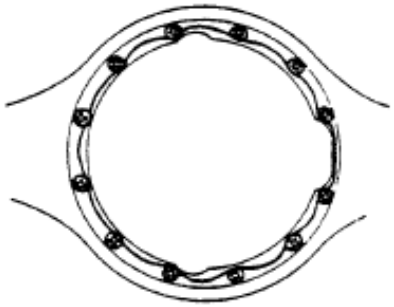
5. Driver-Controlled CTD: Install shift unit on carrier, engaging swivel with slot in shift fork shaft. Install mounting nuts and flat washers. Connect air line to unit.

6. Seasonal CTD: Position curvic clutch in the engaged or disengaged position, then install shift fork cover retainer and secure with self-locking nuts and washers.

NOTE: Shift fork cover retainer can be installed in two different positions; one to keep the sliding curvic clutch engaged, and the other to keep it disengaged. In the engaged position the shift fork cover retainer will have the adjusting screw facing the carrier, and away from the carrier in the disengaged position.

IMPORTANT: When axle has been disassembled or housing, gears, axle shafts or wheel equipment replaced, check axle assembly for proper differential action before operating vehicle. Wheels must rotate freely and independently.

Silicone Gasket Compound Pattern. Differential Carrier Mating Surface.



These instructions include service and maintenance for four variations in 4x4 Drive Shift Systems, as shown in the index below.

Contents — **Section 8, Page No.**

4x4 DRIVE SHIFT SYSTEMS

Single Reduction or Double Reduction Axles 2

Single Reduction with Controlled Traction Differentials 2

Dual Range Axles with Range Interlock 4

Dual Range Rear Axle with Single Reduction Steer-Drive 9

SHIFT SYSTEM COMPONENTS

Air Shifter Valves 15

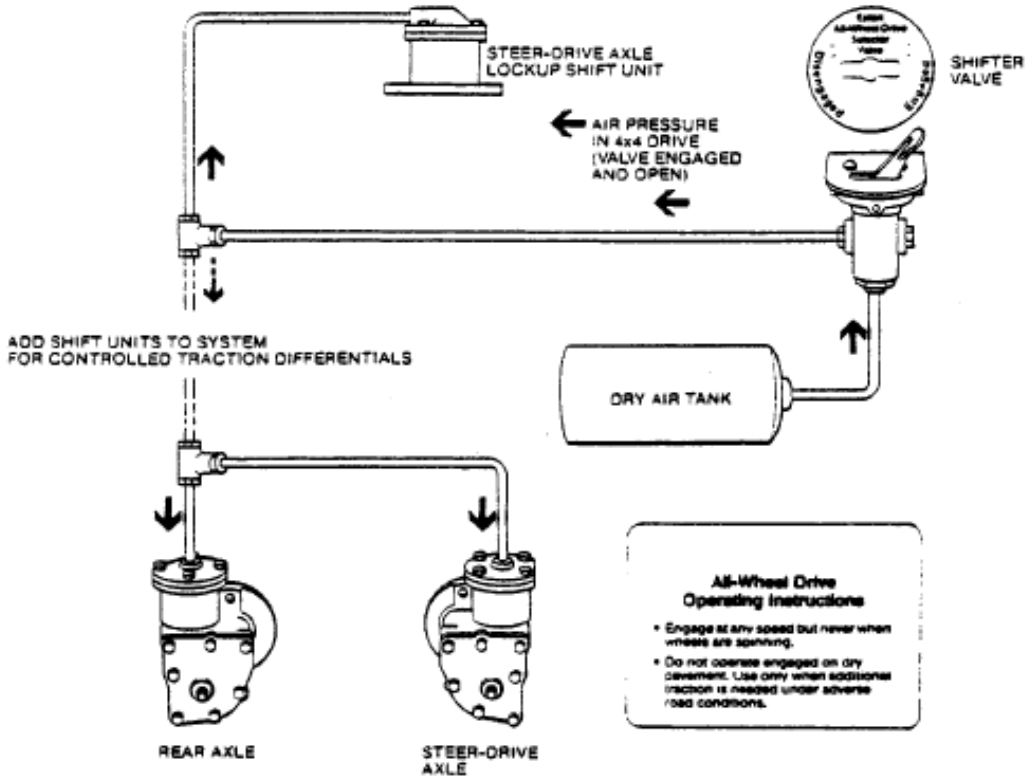
"Standard" Lockup Shift Unit 16

'Interlock Type" Lockup Shift Unit 14

Special Components 17

Air Shift Unit (Dual Range Selection and Controlled Traction Differential) 18

Single Reduction Axles with Standard or Controlled Traction Differentials
Double Reduction Axles with Standard Differentials


STEER-DRIVE AXLE LOCKUP SHIFT UNIT
SHIFTER VALVE
AIR PRESSURE IN 4x4 DRIVE (VALVE ENGAGED AND OPEN)
ADD SHIFT UNITS TO SYSTEM FOR CONTROLLED TRACTION DIFFERENTIALS
DRY AIR TANK
All-Wheel Drive Operating Instructions
REAR AXLE
STEER-DRIVE AXLE

CONTROLLED TRACTION DIFFERENTIAL SHIFT UNITS

Description and Operation

These systems provide selection of two operational modes: 4x4 and 4x2.

When the system includes Controlled Traction Differentials, these units are engaged (and operating) in 4x4 drive and disengaged in 4x2 drive. With an additional valve in the cab, the system may be set up for independent control of Controlled Traction Differential Operation.

Steer-Drive Axle Lockup

A manually operated shifter valve controls air pressure supply to the shift unit which, in turn, engages or disengages the steer-drive axle.

The shift unit is mechanically connected to a shift fork and sliding clutch. The clutch engages or disengages a drive gear to engage or disengage the drive to the steer-drive axle.

For detailed operation description, see page 8—3.

Controlled Traction Differentials

Two shift units (one on each axle) engage or disengage controlled traction differentials.

Engaged. When shifter valve lever is moved to the engaged position, the valve is opened and air pressure is applied to the shift units. Each shift unit is mechanically connected to a shift fork and a sliding clutch. The sliding clutch moves to engage the controlled traction differential. In the engaged position, the unit is operational as a biasing differential.

Disengaged. When shifter valve lever is moved to the disengaged position, the valve is closed. Air pressure in each shift unit is exhausted. The sliding clutch retracts and disengages the controlled traction differential. In the disengaged position, the unit functions with conventional differential action. For operational description of the shift unit, see page 8—18.

Steer-Drive Axle Lockup Shift Unit Operation

Description: This shift unit is of the straight-air type. Air-operated for engagement and spring-released for disengagement. The piston is mechanically connected to a snift fork and sliding clutch. The clutch engages or disengages a drive gear to engage and disengage the steer-drive axle.

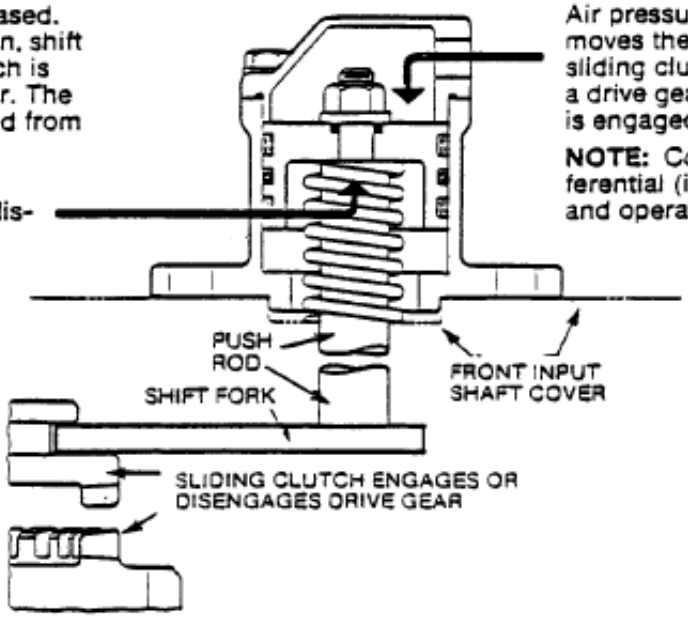
Disengaged

When the shifter valve lever is moved to the disengaged position, this valve is closed and air pressure in the shift unit is exhausted.

Air pressure at piston is released. Spring pressure moves piston, shift fork and sliding clutch. Clutch is disengaged from a drive gear. The steer-drive axle is disengaged from the drive train.

NOTE: Controlled Traction Differential (if equipped) is disengaged and not operating.

Lockup Shift Unit



Engaged

When the shifter valve lever is moved to the engaged position, the valve is opened and supplies air pressure to the shift unit.

Air pressure enters the cover and moves the piston, shift fork and sliding clutch. The clutch engages a drive gear. The steer-drive axle is engaged into the drive train.

NOTE: Controlled Traction Differential (if equipped) is engaged and operating.

Troubleshooting

Check for Air Pressure and Air Leaks

A simple method for quickly locating troubles in a shift system can be accomplished by listening for possible air leaks and for sound (or feel by hand) which would indicate mechanical shifting.

Steer-Drive Axle and Controlled Traction Differential Shift Systems

1. Initial Preparation. Start system check by placing All-Wheel Drive selector valve lever in Disengaged position. Move vehicle in forward direction for a short distance, then back vehicle up an equal distance. Repeat this at least three times. This will insure that all clutches are in proper position. If possible, park vehicle on a flat surface and do not apply spring brakes. Do not move the vehicle until system checks are completed. Lastly, insure that sufficient air pressure is built up to perform system checks. Turn engine off.

2. Move shifter valve lever to the Engaged position. In this position, air pressure should be present in the entire system. Check for air leaks. With Controlled Traction Differentials, be sure to check axle shift units and air lines.

3. Move shifter valve lever to the Disengaged position. In this position, air pressure should be present only up to shifter valve.

4. Operate shifter valve lever back and forth. If the shift units are operating, a definite reaction will be evident by sound of parts movement.

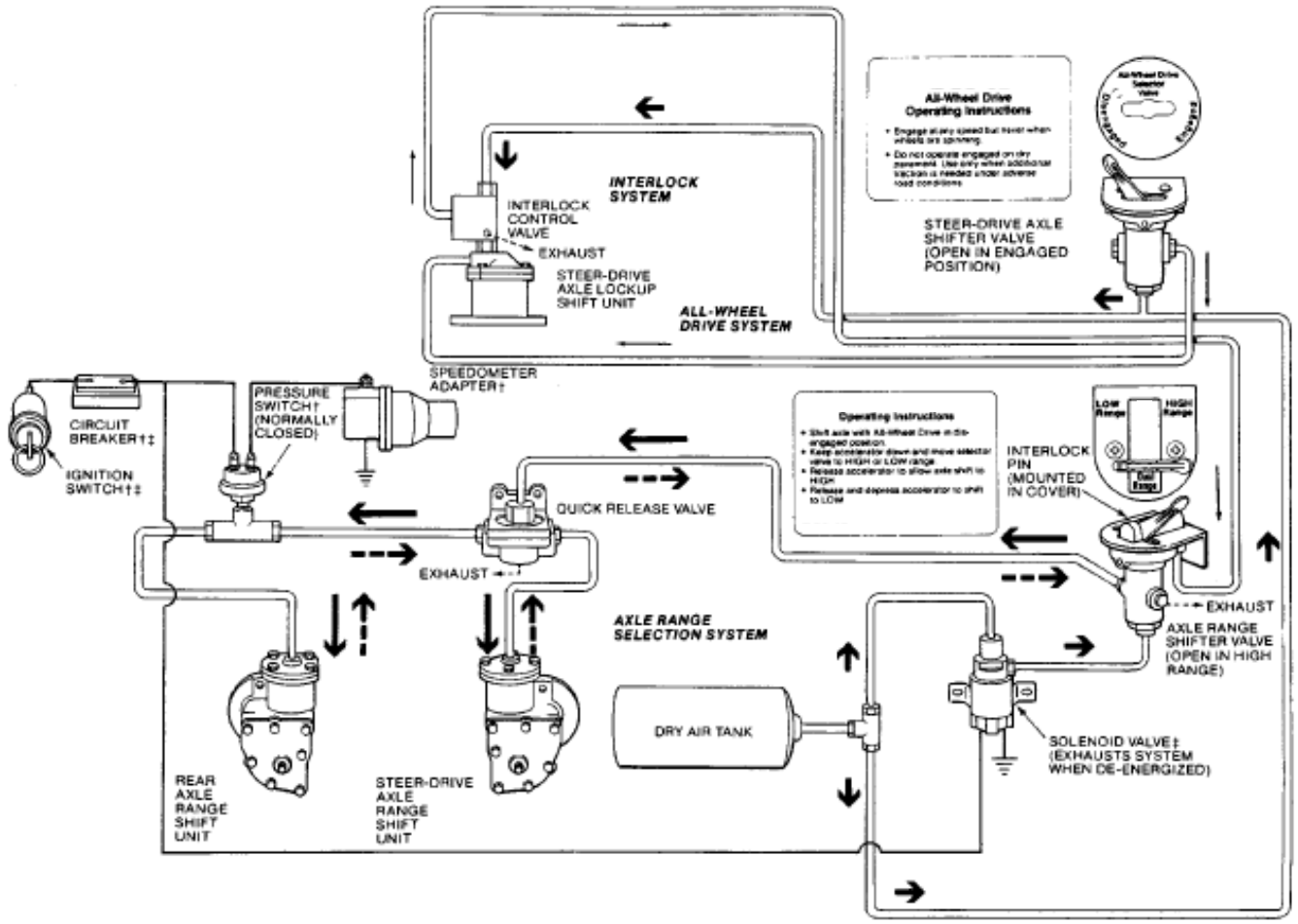
5. If air pressure is satisfactory and shift units do not function, disassemble and inspect shift units.

Description and Operation

Operational Modes:

- 4x2 Drive with axles in High or Low Range
- 4x4 Drive with axles in High or Low Range

The system includes an interlocking feature that prevents axle range shift when in 4x4 drive.



† Pressure switch and speedometer adapter required for vehicles with transmission drive speedometers.

‡ Solenoid valve required for vehicles not equipped with automatic safety brakes.

→ CONSTANT AIR SUPPLY.

⟶ AIR FLOW TO AXLE RANGE SHIFT UNITS FROM AIR SUPPLY (AXLES IN HIGH RANGE)

⇢ AIR FLOW FROM AXLE RANGE SHIFT UNITS TO EXHAUST (AXLES IN LOW RANGE).

—→ AIR FLOW THROUGH ALL-WHEEL DRIVE AND INTERLOCK SYSTEMS IN 4x4 DRIVE (SEE PAGE 8—6 FOR DETAILS).

NOTE: Axle Range shift cannot be made unless Steer-Drive Axle shifter valve is disengaged (4x2 drive). Also, the system wrap-up torques in the drivetrain may prevent immediate disengagement of the Steer-Drive Axle clutch (even though the All-Wheel Drive selector valve is disengaged). Backing the vehicle or continuing in a forward direction for sufficient time to release these wrap-up torques is necessary before clutch will disengage. Interlock pin on range selector shifter valve will then retract, allowing range selection as desired.

Description and Operation

Axle Range Shift System

One manually-operated shifter valve changes range of both axles. This valve is equipped with an interlock pin assembly which prevents axle range shifting in 4x4 drive.

Two air shift units (mounted on the axles) are mechanically connected to the axle shift forks and sliding clutch gears which, in turn, shift axles into Low or High Range.

One quick release valve provides fast release of air pressure from all both axle shift units.

For vehicles not equipped with automatic safety brakes, an ignition-controlled solenoid valve exhausts the system and downshifts the axles when the ignition switch is turned off. The electrical circuit is protected by a circuit breaker.

For vehicles equipped with transmission-drive speedometers, the system includes a speedometer adapter which compensates speedometer readings when axles are in Low Range. The adapter is operated by an electrical switch mounted on or near the quick-release valve. The switch is normally closed and is opened by air pressure.

With axles in Low Range, the switch is closed and the adapter is energized. The adapter operates with a ratio compatible with the axle Low Range for proper road speed readings. With axles in High Range, the air lines are pressurized and the pressure switch is open. The adapter now operates with 1:1 ratio for proper speed readings in High Range.

Axle Range Shift System Operation (must be in 4x2 drive)

High Range. When shifter valve lever is moved to High Range, the valve is opened and air pressure is supplied through the quick release valve to the axle shift units. When driveline torque is interrupted, the shift units will shift axles to High Range.

Low Range. When shifter valve lever is moved to Low Range, the valve is closed. Air pressure in the shift units is exhausted through the quick release valve. When driveline torque is interrupted, axles are shifted to Low Range and held in this position by shift unit return springs.

NOTE: In 4x4 drive, axle range shifter valve lever is blocked and range cannot be changed.

Axle Range Interlock System

The interlock system prevents changing axle range when drive is in 4x4 mode.

The system includes an interlock control valve (mounted on the steer-drive lockup shift unit) and an interlock pin (mounted in cover of the axle range shifter valve).

The interlock system controls delivery of air pressure to the axle range shifter valve interlock pin, which, in turn, operates to lock the range shifter valve lever position and prevent axle range shifting.

Steer-Drive Axle Lockup

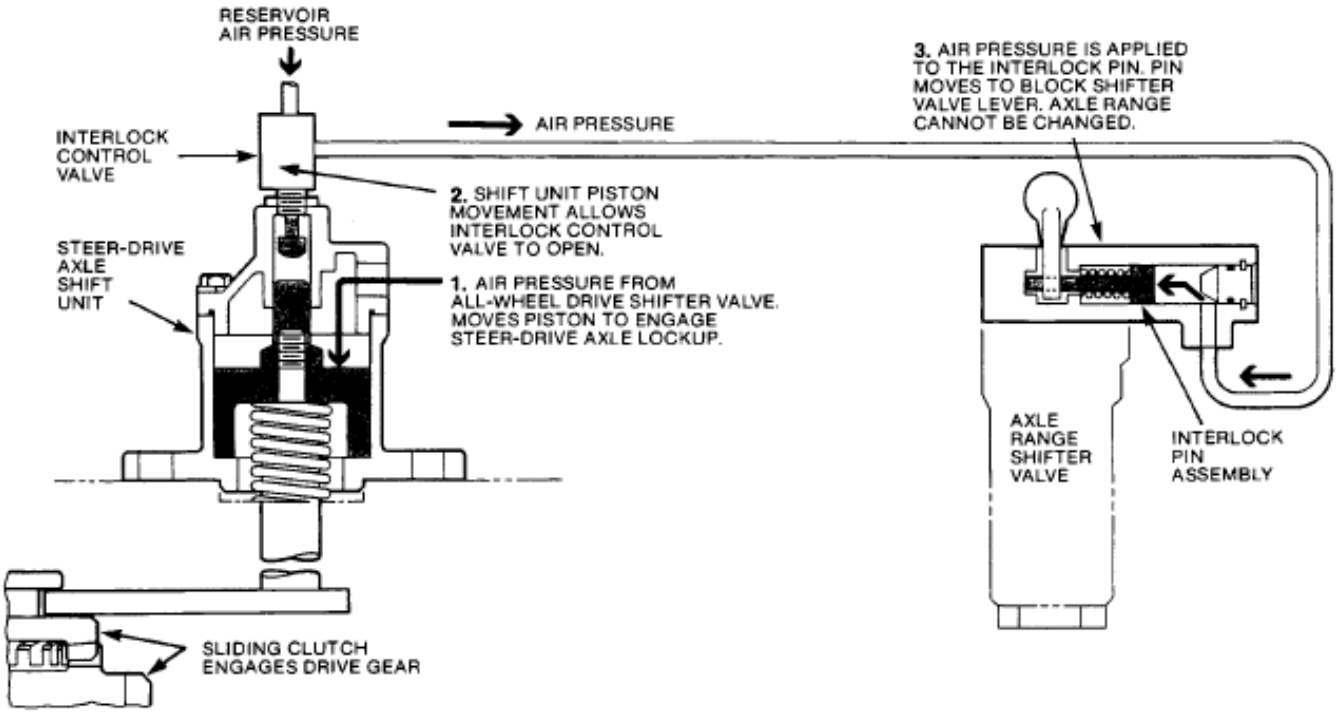
One manually-operated shifter valve is used to control the steer-drive axle lockup shift unit mounted on the rear axle. The shift unit is mechanically connected to a shift fork and a sliding clutch. The operational modes of the steer-drive axle are controlled by movement of the sliding clutch.

When the shifter valve is in the engaged position, the steer-drive axle lockup is engaged providing 4x4 drive.

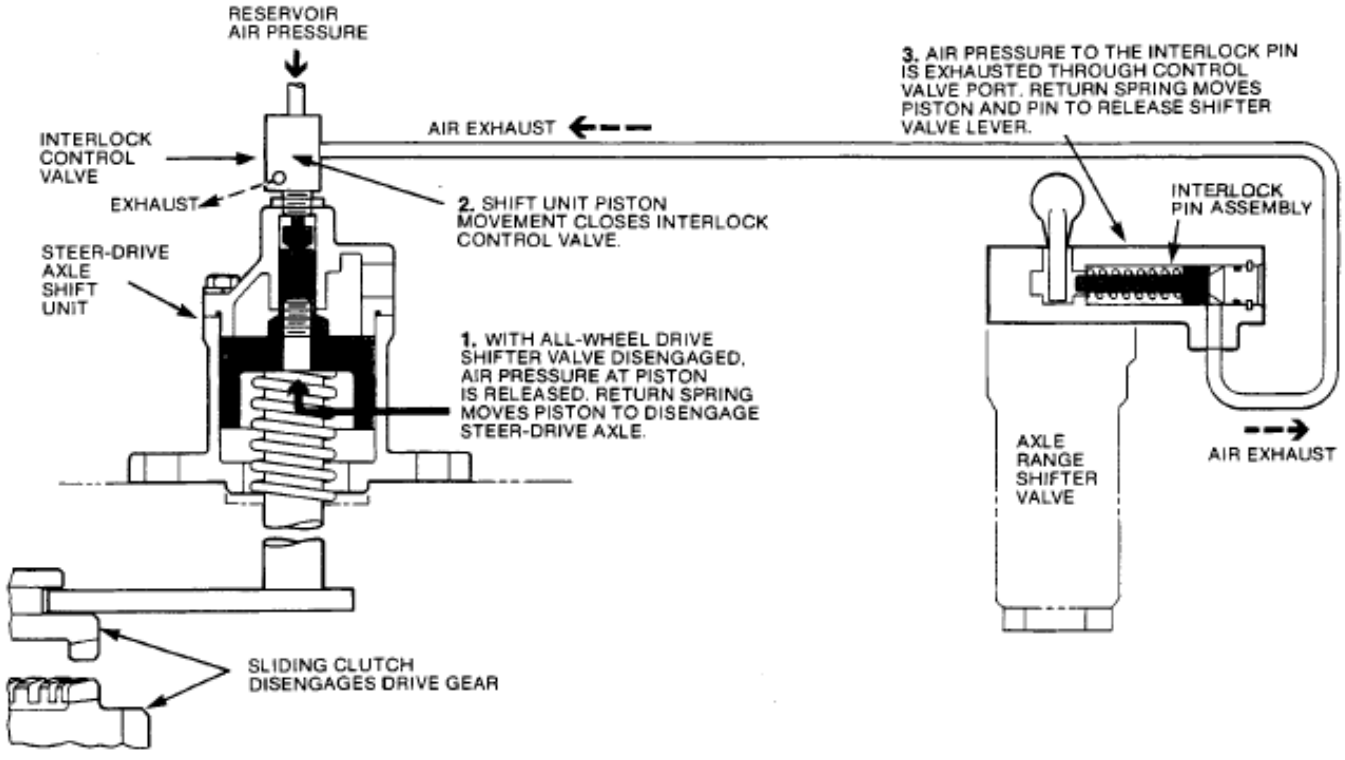
With the shifter valve in the disengaged position, the steer-drive axle lockup is disengaged for 4x2 operation.

Interlock System Operation *(with Dual Range Axles)*

Interlock Engaged (4x4 Operation)


RESERVOIR AIR PRESSURE
INTERLOCK CONTROL VALVE
AIR PRESSURE
3. AIR PRESSURE IS APPLIED TO THE INTERLOCK PIN. PIN MOVES TO BLOCK SHIFTER VALVE LEVER. AXLE RANGE CANNOT BE CHANGED.
2. SHIFT UNIT PISTON MOVEMENT ALLOWS INTERLOCK CONTROL VALVE TO OPEN.
STEER-DRIVE AXLE SHIFT UNIT
1. AIR PRESSURE FROM ALL-WHEEL DRIVE SHIFTER VALVE. MOVES PISTON TO ENGAGE STEER-DRIVE AXLE LOCKUP.
AXLE RANGE SHIFTER VALVE
INTERLOCK PIN ASSEMBLY
SLIDING CLUTCH ENGAGES DRIVE GEAR

Interlock Disengaged (4x2 Operation)


RESERVOIR AIR PRESSURE
3. AIR PRESSURE TO THE INTERLOCK PIN IS EXHAUSTED THROUGH CONTROL VALVE PORT. RETURN SPRING MOVES PISTON AND PIN TO RELEASE SHIFTER VALVE LEVER.
AIR EXHAUST
INTERLOCK CONTROL VALVE
EXHAUST
2. SHIFT UNIT PISTON MOVEMENT CLOSES INTERLOCK CONTROL VALVE.
INTERLOCK PIN ASSEMBLY
STEER-DRIVE AXLE SHIFT UNIT
1. WITH ALL-WHEEL DRIVE SHIFTER VALVE DISENGAGED, AIR PRESSURE AT PISTON IS RELEASED. RETURN SPRING MOVES PISTON TO DISENGAGE STEER-DRIVE AXLE.
AXLE RANGE SHIFTER VALVE
AIR EXHAUST
SLIDING CLUTCH DISENGAGES DRIVE GEAR

Trouble-Shooting

The following procedure is presented in step-by-step sequence which enables checking the operation of all integrated systems and components.

1. Initial Preparation. Start system check by placing axle range shifter valve lever in Low Range position and All-Wheel Drive selector valve lever in disengaged position. Move vehicle in forward direction for a short distance, then back vehicle up an equal distance. Repeat this at least three times. This will insure that all clutches are in proper position. Also, park vehicle on a flat surface and do not apply spring brakes. Do not move the vehicle until system checks are completed. Lastly, insure that sufficient air pressure is built up to perform system checks. Turn engine off.

2. Check Solenoid Valve. If vehicle is equipped with solenoid valve, turn ignition "ON" to energize and open valve. Check to insure that air pressure is present at the outlet of the solenoid valve.

3. Check Axle Range Shift System. Have an assistant in the cab begin moving the axle range valve lever in the cab between Low and High Range. Listen for mechanical movement at the rear axle range shift unit and the steer-drive axle range shift unit. If no movement is apparent, place the axle range valve lever in the Low Range position and disconnect air lines at the rear axle and the steer-drive axle range shift units. Place axle range valve lever in High Range position. Air flow should be present through the disconnected air lines. If air flow is *not* present, inspect the axle range shifter valve and the quick release valve. Replace as required.

Place axle range valve lever in Low Range position. Air flow should *not* be present in any of the disconnected air lines.

Reconnect air lines and insure that sufficient air supply exists to perform following checks to the remainder of the system.

4. Check Lockup System. Have an assistant move the All-Wheel Drive selector valve lever from disengaged to engaged position. Check for mechanical movement in the steer-drive axle lockup shift unit mounted on the rear axle.

Disconnect air line from cover of the steer-drive axle lockup shift unit with selector valve lever in disengaged position.

(**NOTE:** This air line is *not* to be confused with air line connected to interlock control valve installed in shift unit cover. Leave this air line connected.) Place All-Wheel Drive selector valve lever in engaged position and check for air flow at disconnected air line. Place selector valve lever in disengaged position and insure air flow is discontinued. If not, remove All-Wheel Drive selector valve and inspect. Replace as required. Place selector valve lever in disengaged position and reconnect air line. Proceed to next step after insuring sufficient air pressure is available to continue system checks.

5. Check Interlock System. Move the All-Wheel Drive selector valve lever to engaged position and check axle dual range shifter valve lever to make sure the interlock pin actuates (interlock pin locks the valve lever and prevents movement of the lever when in All-Wheel Drive). Move the selector valve lever to disengaged position and check for retraction of the interlock pin on the axle range shifter valve. If interlock pin functions correctly, system check is complete. If not, proceed to Step 5a.

a. If interlock pin does not function correctly, move All-Wheel Drive selector valve lever to disengaged position, then disconnect air line on the side of the interlock control valve. Move the All-Wheel Drive selector valve lever to engaged position and check for air flow from side port of interlock control valve. If air flow is *not* present, place selector valve lever in disengaged position and remove interlock control valve from shift unit cover.

b. Place All-Wheel Drive selector valve lever in engaged position and again check for air flow from the side port of the interlock control valve. If air flow is present, depress plunger on interlock control valve and insure air supply is shut off from valve side port. If valve does not function correctly, remove and replace. Place All-Wheel Drive selector valve lever in disengaged position and reinstall interlock control valve in shift unit cover and adjust properly (see page 8—16). Place All-Wheel Drive selector valve lever in engaged position. If air flow is still *not* present at valve side port, remove shift unit from rear axle and inspect components for binding or excessive wear. After repair, follow the above steps until proper functioning is obtained.

c. Reconnect air line and place All-Wheel Drive selector valve lever in the engaged position. If interlock pin on axle range shifter valve does *not* actuate, proceed to Step d. If interlock pin functions correctly, system is operating correctly and check is complete.

d. If interlock pin still does *not* actuate when All-Wheel Drive selector valve lever is placed in engaged position, remove axle range shifter valve in cab and inspect assembly for component wear or binding. After repairing, check for correct operation by placing All-Wheel Drive selector valve lever in engaged position and insuring that interlock pin on axle range shifter valve actuates, and also that it retracts when All-Wheel Drive selector valve lever is placed in disengaged position.

Trouble-Shooting (cont'd)

Check Electrical System

Check Solenoid Valve

1. When ignition switch is "ON," solenoid valve is energized and air pressure is available to operate the system. When ignition switch is "OFF," solenoid valve is de-energized and exhausts the system which downshifts axle to low range. Check wiring and circuit breaker for defects that would cause shorts or open circuits.

2. Make sure valve has a good ground connection to the frame. With power at valve, check operation as follows: Disconnect lead wire and air line outlet at valve and install air pressure gauge.

Apply power to valve and observe air gauge reading. Operating pressure should be approximate reservoir pressure.

If gauge indicates approximate pressure, valve is okay.

If gauge indicates low or no pressure, valve is faulty. Replace valve assembly.

Check Speedometer Adapter

1. Make sure adapter is grounded to vehicle chassis.

2. Check wiring for shorts or grounds and trace electrical circuit from ignition switch through circuit breaker, pressure switch to adapter.

3. Check for power supply at adapter terminal. With axle shifter valve in High Range, pressure switch is open and power is not delivered to adapter. With shifter valve in Low Range, the pressure switch is closed and power is delivered to operate the speedometer adapter. If power supply is okay, adapter is faulty. Replace adapter assembly.

Check Pressure Switch

In Low Range, the pressure switch is closed and electrical circuit is complete to the speedometer adapter. In High Range, air pressure opens the pressure switch, breaks the electric circuit to the speedometer adapter.

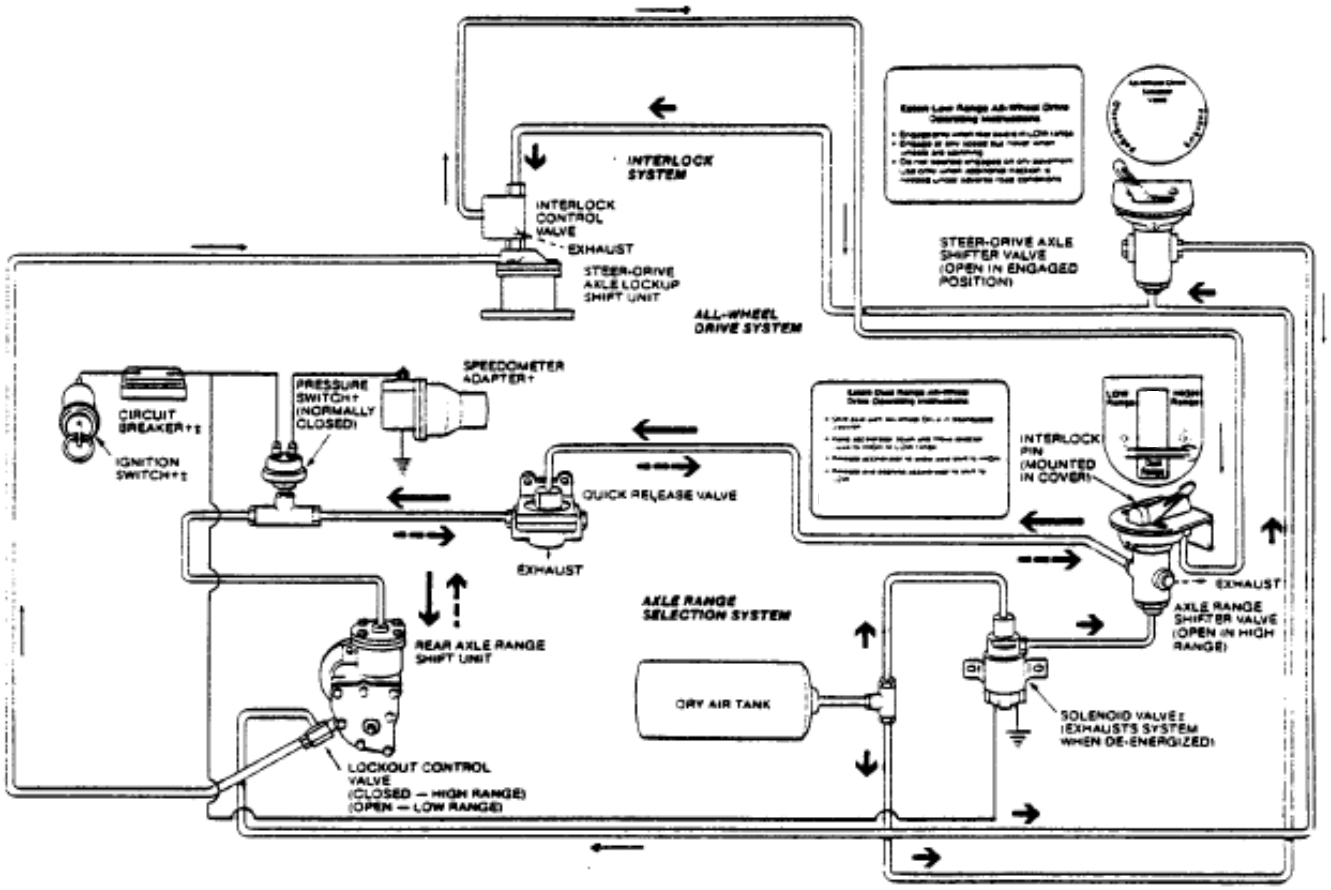
To check pressure switch operation, shift to High Range and probe switch terminals. No voltage should be present. Replace a faulty pressure switch as an assembly.

Description and Operation

Operational Modes:

	Steer-Drive Axle	Rear Axle
4x4 Drive	Engaged	Low Range
4x2 Drive	Disengaged	Low Range
4x2 Drive	Disengaged	High Range

The system includes an interlocking feature that prevents axle range shift when in 4x4 drive.


INTERLOCK SYSTEM
INTERLOCK CONTROL VALVE
EXHAUST
STEER-DRIVE AXLE LOCKUP SHIFT UNIT
ALL-WHEEL DRIVE SYSTEM
STEER-DRIVE AXLE SHIFTER VALVE (OPEN IN ENGAGED POSITION)
SPEEDOMETER ADAPTER†
PRESSURE SWITCH† (NORMALLY CLOSED)
CIRCUIT BREAKER†‡
IGNITION SWITCH†‡
QUICK RELEASE VALVE
EXHAUST
INTERLOCK PIN (MOUNTED IN COVER)
EXHAUST
AXLE RANGE SHIFTER VALVE (OPEN IN HIGH RANGE)
AXLE RANGE SELECTION SYSTEM
REAR AXLE RANGE SHIFT UNIT
DRY AIR TANK
SOLENOID VALVE‡ (EXHAUSTS SYSTEM WHEN DE-ENERGIZED)
LOCKOUT CONTROL VALVE (CLOSED — HIGH RANGE) (OPEN — LOW RANGE)

† Pressure switch and speedometer adapter required for vehicles with transmission drive speedometers.

‡ Solenoid valve required for vehicles not equipped with automatic safety brakes.

→ CONSTANT AIR SUPPLY.

⟶ AIR FLOW TO AXLE RANGE SHIFT UNIT (REAR AXLE IN HIGH RANGE).

⟿ AIR FLOW FROM AXLE RANGE SHIFT UNIT TO EXHAUST (REAR AXLE IN LOW RANGE).

—— AIR FLOW THROUGH ALL-WHEEL DRIVE AND INTERLOCK SYSTEMS IN 4x4 DRIVE (REAR AXLE IN LOW RANGE) (SEE PAGE 8—11 FOR DETAILS).

NOTE: Interlock system prevents axle range shift unless steer-drive axle shifter valve is disengaged. Also, the system wrap-up torques in the drivetrain may prevent immediate disengagement of the steer-drive axle clutch (even though the All-Wheel Drive selector valve is disengaged). Backing the vehicle or continuing in a forward direction for sufficient time to release these wrap-up torques is necessary before clutch will disengage. Interlock pin on range selector shifter valve will then retract, allowing range selection as desired.

Description and Operation

Axle Range Shift System

A manually-operated shifter valve changes rear axle range. This valve is equipped with an interlock pin assembly which prevents axle range shifting when steer-drive axle is engaged for 4x4 drive.

An air shift unit, mounted on the rear axle, is mechanically connected to the axle shift fork and sliding clutch gear which, in turn, shifts axle into Low or High Range.

One quick release valve provides fast release of air pressure from the axle shift units.

For vehicles not equipped with automatic safety brakes, an ignition-controlled solenoid valve exhausts the system and downshifts the axle when the ignition switch is turned off. The electrical circuit is protected by a circuit breaker.

For vehicles equipped with transmission-drive speedometers, the system includes a speedometer adapter which compensates speedometer readings when axle is in Low Range. The adapter is operated by an electrical switch mounted on or near the quick-release valve. The switch is normally closed and is opened by air pressure.

With rear axle in Low Range, the switch is closed and the adapter is energized. The adapter operates with a ratio compatible with the axle Low Range for proper road speed readings. With axle in High Range, the air line is pressurized and the pressure switch is open. The adapter now operates with 1:1 ratio for proper speed readings in High Range.

Axle Range Shift System Operation (must be in 4x2 drive)

High Range. When shifter valve lever is moved to High Range, the valve is opened and air pressure is supplied through the quick release valve to the axle shift unit. When driveline torque is interrupted, the shift unit will shift axle to High Range.

Low Range. When shifter valve lever is moved to Low Range, the valve is closed. Air pressure in the shift unit is exhausted through the quick release valve. When driveline torque is interrupted, axle is shifted to Low Range and held in this position by shift unit return spring.

NOTE: In 4x4 drive, axle range shifter valve lever is blocked and range cannot be changed.

Interlock System

The interlock system consists of a lockout control valve (mounted on the Axle Range shift unit), and an interlock control valve (mounted on the steer-drive lockup shift unit).

This interlocking system delivers air pressure to the axle range shifter valve interlock pin (when in 4x4 drive), which, in turn, operates to lock the range shifter lever in axle Low Range.

When in 4x2 drive with axle in High Range, the lockout control valve is closed and prevents shifting to 4x4 drive.

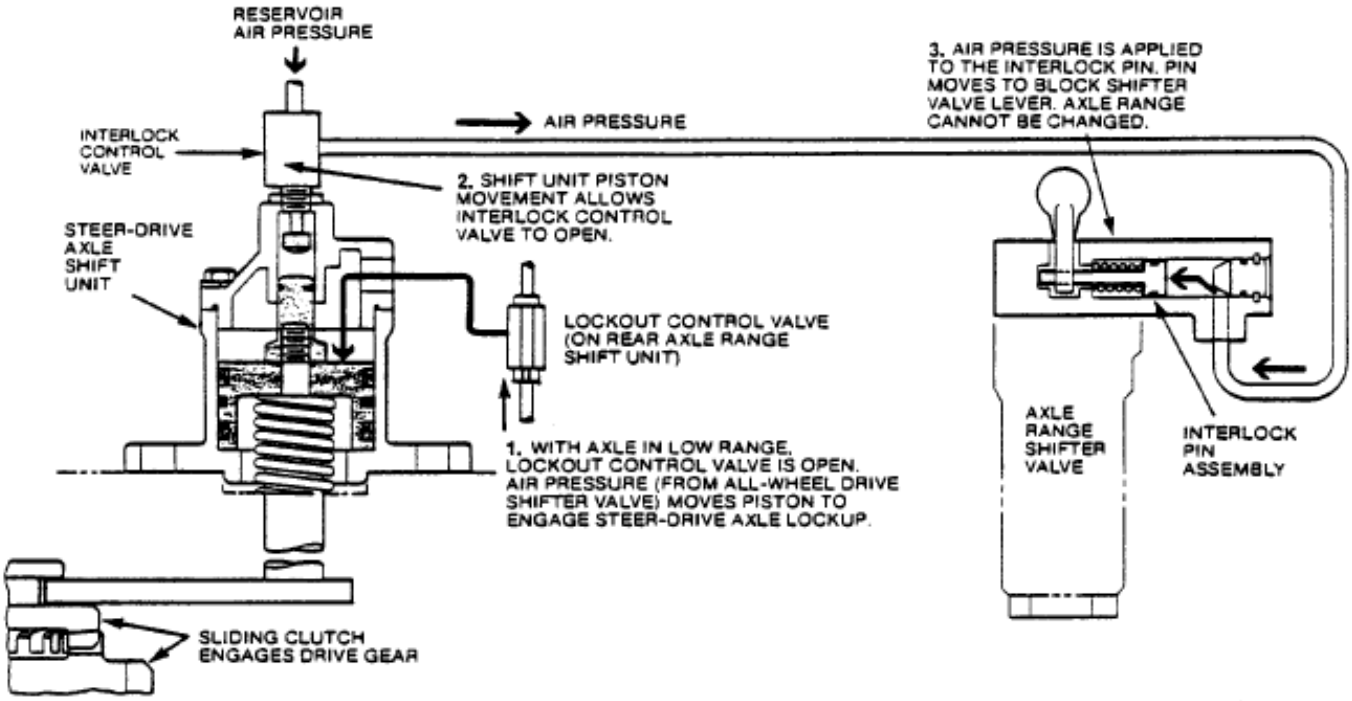
Steer-Drive Axle Lockup

A manually-operated All-Wheel Drive shifter valve is used to control a shift unit mounted on the rear axle. This shift unit is mechanically connected to a shift fork and a sliding clutch. The operational modes of the steer-drive axle are controlled by movement of the sliding clutch.

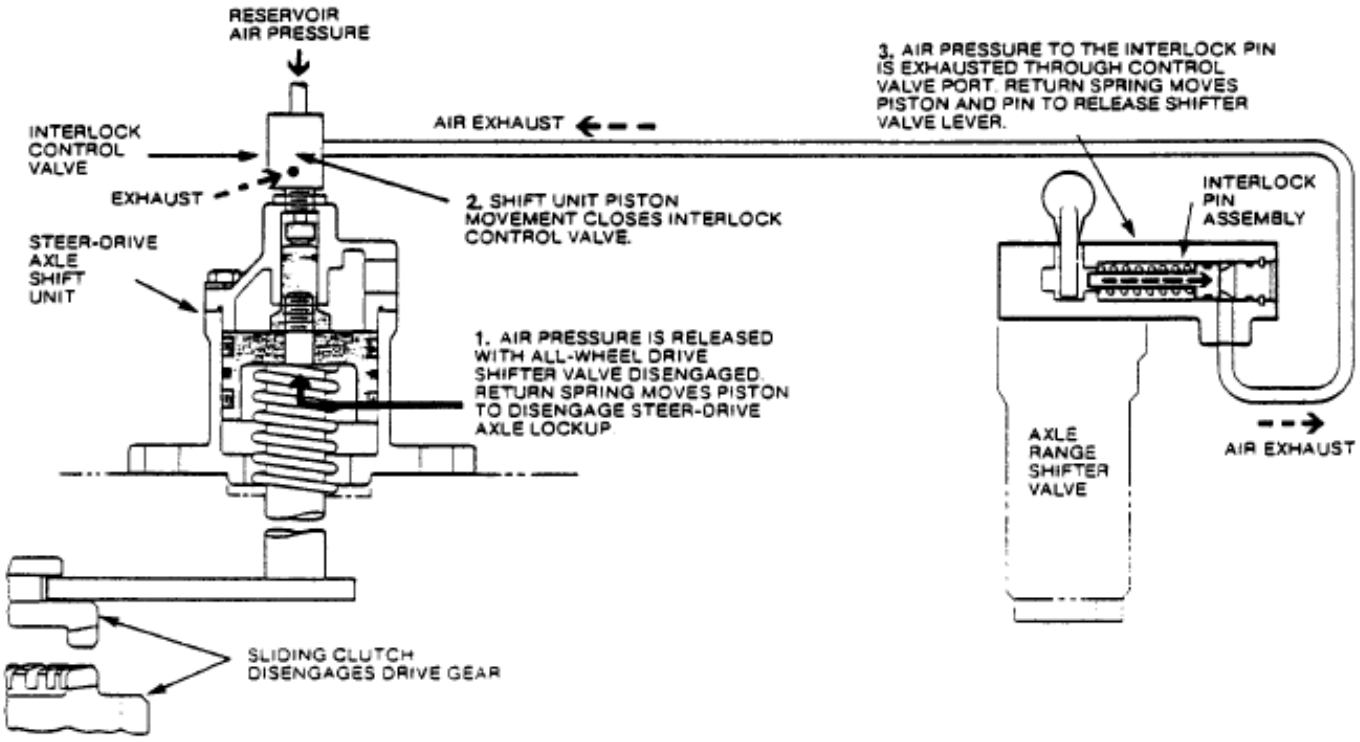
With the shifter valve in the engaged position, the drive to the steer-drive axle is engaged for 4x4 drive (rear axle in Low Range). With the shifter valve in the disengaged position, the drive to the steer-drive axle is disengaged for 4x2 operation.

Interlock System Operation *(with Dual Range Rear Axle)*

Interlock Engaged (4x4 Operation) (Rear Axle in Low Range)


RESERVOIR AIR PRESSURE
INTERLOCK CONTROL VALVE
AIR PRESSURE
3. AIR PRESSURE IS APPLIED TO THE INTERLOCK PIN. PIN MOVES TO BLOCK SHIFTER VALVE LEVER. AXLE RANGE CANNOT BE CHANGED.
2. SHIFT UNIT PISTON MOVEMENT ALLOWS INTERLOCK CONTROL VALVE TO OPEN.
STEER-DRIVE AXLE SHIFT UNIT
LOCKOUT CONTROL VALVE (ON REAR AXLE RANGE SHIFT UNIT)
AXLE RANGE SHIFTER VALVE
INTERLOCK PIN ASSEMBLY
1. WITH AXLE IN LOW RANGE, LOCKOUT CONTROL VALVE IS OPEN. AIR PRESSURE (FROM ALL-WHEEL DRIVE SHIFTER VALVE) MOVES PISTON TO ENGAGE STEER-DRIVE AXLE LOCKUP.
SLIDING CLUTCH ENGAGES DRIVE GEAR

Interlock Disengaged (4x2 Operation)


RESERVOIR AIR PRESSURE
3. AIR PRESSURE TO THE INTERLOCK PIN IS EXHAUSTED THROUGH CONTROL VALVE PORT. RETURN SPRING MOVES PISTON AND PIN TO RELEASE SHIFTER VALVE LEVER.
INTERLOCK CONTROL VALVE
AIR EXHAUST
EXHAUST
2. SHIFT UNIT PISTON MOVEMENT CLOSES INTERLOCK CONTROL VALVE.
INTERLOCK PIN ASSEMBLY
STEER-DRIVE AXLE SHIFT UNIT
1. AIR PRESSURE IS RELEASED WITH ALL-WHEEL DRIVE SHIFTER VALVE DISENGAGED. RETURN SPRING MOVES PISTON TO DISENGAGE STEER-DRIVE AXLE LOCKUP
AXLE RANGE SHIFTER VALVE
AIR EXHAUST
SLIDING CLUTCH DISENGAGES DRIVE GEAR

Trouble-Shooting

The following procedure is presented in step-by-step sequence which enables checking the operation of all integrated systems and components.

1. Initial Preparation. Start system check by placing axle range shifter valve lever in Low Range position and All-Wheel Drive selector in disengaged position. Move vehicle in forward direction for a short distance, followed by backing vehicle up an equal distance. Repeat this at least three times. This will insure that all clutches are in proper position. Also, park vehicle on a flat spot and do not apply spring brakes. Do not move the vehicle until system checks are completed. Lastly, insure that sufficient air pressure is built up to perform system checks. Turn engine off.

2. Check Solenoid Valve. Turn engine off. If vehicle is equipped with solenoid valve, turn ignition "ON" to energize and open valve. Check to insure that air pressure is present at the outlet of the solenoid valve.

3. Check Axle Range Shift System. Have an assistant in the cab begin moving the axle range shifter valve lever in the cab between Low and High Range. Listen for mechanical movement at the rear axle range shift unit. If no movement is apparent, place the shifter valve lever in the Low Range position and disconnect air line at the rear axle range shift unit. Place shifter valve lever in High Range position. Air flow should be present through the disconnected air line. If air flow is *not* present, inspect the axle range shifter valve and the quick release valve. Replace as required.

Place axle range shifter in Low Range position. Air flow should *not* be present in the disconnected air line.

Reconnect air line and insure that sufficient air supply exists to perform following checks to the remainder of the system.

4. Check Lockup System. After insuring that the axle range shifter valve is in the Low Range position, have an assistant move the All-Wheel Drive selector valve lever from disengaged to engaged position. Check for mechanical movement in the steer-drive axle lockup shift unit mounted on the rear axle.

Disconnect the air line from cover of the steer-drive axle lockup shift unit with All-Wheel Drive selector lever in disengaged position. (**NOTE:** This air line is *not* to be confused with air line connected to interlock control valve installed in shift unit cover. Leave this air line connected.) Place All-Wheel Drive selector valve in engaged position and check for air flow at disconnected air line. Place lever in disengaged position and insure air flow is discontinued. If system functions correctly, proceed to Step 7. If *not*, proceed to Step 5.

5. Check Lockout Control Valve. If improper operation is evident in Step 4, the All-Wheel Drive selector valve and/or the lockout control valve mounted in the side of the rear axle range shift unit is malfunctioning.

Starting with the All-Wheel Drive selector valve, disconnect the air line from the side of the valve with the lever in the disengaged position. Move lever to engaged position and check for air flow. Place selector valve in disengaged position and insure air flow stops. Replace valve if it functions incorrectly. Reconnect air line to delivery port and proceed to Step 6.

6. Next, move to the lockout control valve on the rear axle range shift unit. With the All-Wheel Drive selector lever in the engaged position and the axle range selector valve in Low Range, check for air flow from the side port of the lockout control valve. If air flow is not present, remove the valve and test by manually pushing the ball on the valve with air supplied to the end of the valve. With the ball pressed in, air should flow from the delivery port on the valve. With the ball released, air flow should be stopped.

If the valve functions incorrectly, it should be replaced. If it functions correctly, reinstall in the shift unit and insure that air flows through the valve when the All-Wheel Drive selector lever is in the engaged position (axle range shifter valve in Low Range) and is stopped when the lever is in the disengaged position. If this does not occur, the rear axle shift unit must be inspected and repaired. Do not proceed to Step 7 until proper operation is obtained.

7. Place the axle range shifter valve in the High Range position and the All-Wheel Drive selector lever in the engaged position. Return to the lockout control valve and insure that air flow is *not* present at the side port of the valve. This is the feature that prevents All-Wheel Drive operation in High Range. If air flow is present, the lockout control valve and/or axle range shift unit must be inspected. Do not proceed to Step 8 until proper functioning occurs.

NOTE: See next page for Step 8.

Trouble-Shooting (cont'd)

8. Check Interlock System. Place the axle range shifter valve in the Low Range position. This lever must remain in this position for the remainder of the system checks. Move the All-Wheel Drive selector lever to engaged position. On axle dual range shifter valve, insure that interlock pin actuates, which prevents movement of the range selector lever when in All-Wheel Drive. Move the All-Wheel Drive selector lever to the disengaged position and check for retraction of the interlock pin on the axle range selector valve. If interlock pin functions correctly, system check is complete. If not, proceed to Step 8a.

a. If interlock pin does not function correctly, move All-Wheel Drive selector lever to disengaged position, then disconnect air line on the side of the interlock control valve on the steer-drive axle lockup shift unit. Move the All-Wheel Drive selector lever to the engaged position and check for air flow from the side port of the interlock control valve. If air flow is not present, place the selector lever in the disengaged position and remove interlock control valve from shift unit cover.

b. Place All-Wheel Drive selector lever in engaged position and again check for air flow from the side port of the interlock control valve. If air flow is present, depress the plunger on the valve and insure air supply is shut off from the valve side port. If valve does not function correctly, remove and replace. Place All-Wheel Drive selector lever in disengaged position and reinstall interlock control valve in shift unit cover and adjust properly (see page 8—16). Place the All-Wheel Drive selector lever in the engaged position. If air flow is still *not* present at the interlock control valve side port, remove the shift unit from the rear axle and inspect components for binding or excessive wear. After repair, follow the above steps until proper functioning is obtained.

c. Reconnect the air line and place the All-Wheel Drive selector lever in the engaged position. If the interlock pin on the axle range shifter valve does *not* actuate, proceed to the next step. If the interlock pin functions correctly, system is operating correctly and check is complete.

d. If interlock pin still does *not* actuate when All-Wheel Drive selector lever is placed in engaged position, remove the axle range shifter valve in the cab and inspect the assembly for component wear or binding. After repairing, check for correct operation by placing the All-Wheel Drive selector lever in the engaged position and insuring that the interlock pin on the axle range shifter valve activates, and also that it retracts when the All-Wheel Drive selector lever is placed in the disengaged position.

Check Electrical System

Check Solenoid Valve

1. When ignition switch is "ON," solenoid valve is energized and air pressure is available to operate the system. When ignition switch is "OFF," solenoid valve is de-energized and exhausts the system which downshifts axle to low range. Check wiring and circuit breaker for defects that would cause shorts or open circuits.

2. Make sure valve has a good ground connection to the frame. With power at valve, check operation as follows: Disconnect lead wire and air line outlet at valve and install air pressure gauge.

Apply power to valve and observe air gauge reading. Operating pressure should be approximate reservoir pressure.

If gauge indicates approximate pressure, valve is okay.

If gauge indicates low or no pressure, valve is faulty. Replace valve assembly.

Check Speedometer Adapter

1. Make sure adapter is grounded to vehicle chassis.

2. Check wiring for shorts or grounds and trace electrical circuit from ignition switch through circuit breaker, pressure switch to adapter.

3. Check for power supply at adapter terminal. With axle shifter valve in High Range, pressure switch is open and power is not delivered to adapter. With shifter valve in Low Range, the pressure switch is closed and power is delivered to operate the speedometer adapter. If power supply is okay, adapter is faulty. Replace adapter assembly.

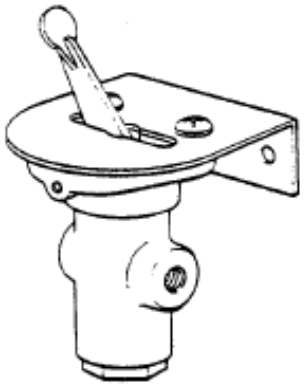
Check Pressure Switch

In Low Range, the pressure switch is closed and electrical circuit is complete to the speedometer adapter. In High Range, air pressure opens the pressure switch, breaks the electric circuit to the speedometer adapter.

To check pressure switch operation, shift to High Range and probe switch terminals. No voltage should be present. Replace a faulty pressure switch as an assembly.

Air Shifter Valves

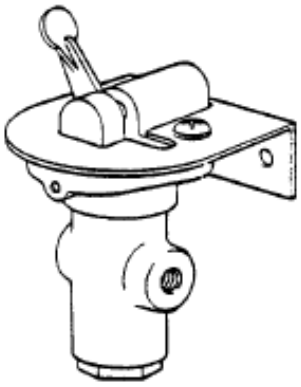
Typical Air Shifter Valve for All-Wheel Drive Selection

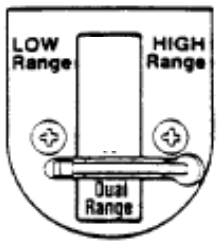


All-Wheel Drive Selection Instruction Plate

Service Instructions
For valve repair instructions, refer to pertinent manufacturer's literature.

Typical Air Shifter Valve for Axle Range Selection with Interlock Pin

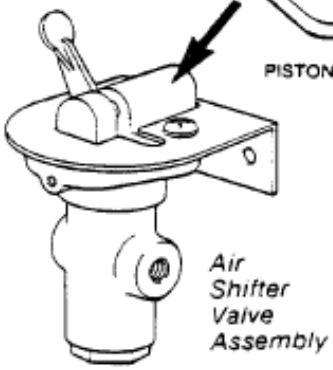




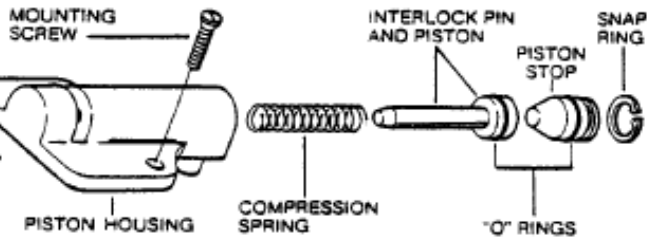
Axle Range Selection Instruction Plate

Service Instructions
For valve repair instructions, refer to pertinent manufacturer's literature. See below for Interlock Pin Assembly repair.

Axle Range Shifter Valve Interlock Pin Assembly



Air Shifter Valve Assembly



* **NOTE:** The interlock pin assembly may be disassembled for cleaning and inspection. However, parts are only available as a complete assembly (shifter valve and interlock assembly).

* **Disassemble Pin.** Remove snap ring, then remove piston stop, piston and spring from piston housing.

NOTE: Before reassembly, lubricate "O" rings with a high-viscosity silicone oil or barium grease "O" ring lubricant.

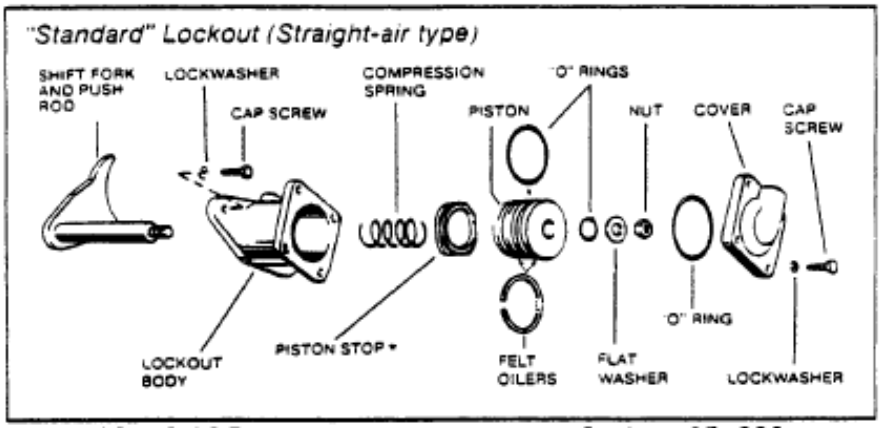
Assemble Pin. Install "O" rings on piston and piston stop. Insert spring, piston and piston stop in housing and secure with snap ring.

NOTE: Interlock pin and piston must reciprocate freely in the piston housing when compressed against the compression return spring.

NOTE: For ease of assembly, insert a pin or drill bit (5/64" max. diameter) into the piston stop to guide the piston stop as it is installed into the piston housing.

Shift Units for "Standard Type" Inter-axle Differential Lockout and Steer-Drive Axle Lockup

(Single Reduction Rear Axles and Steer-Drive Axles)



*PISTON STOP: Used only on 4x4 Axle Series 185, 220 and 6x6 Axle Series D346-P, 386-P, 406-P.

NOTE: Inter-axle differential lockout shift unit is only used on 6x6 drive systems.

Disassemble Shift Unit

1. Remove cap screws and lockwashers fastening cover to body. Remove cover and "O" ring.

2. Remove nut, flat washer and "O" ring from push rod.

3. Remove body cap screws and lockwashers, then remove body and piston as an assembly. Remove "O" ring and felt oilers from piston.

Assemble Shift Unit

1. Apply silicone gasket compound to mounting surface on power divider cover. See illustration above.

2. Install lockout body. Secure with cap screws and lockwashers. Torque cap screws to 48-56 ft-lbs. (65-76 N·m).

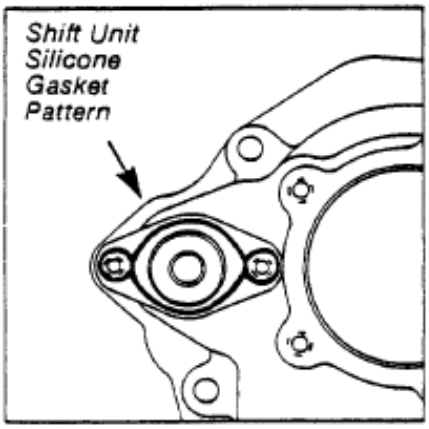
NOTE: Before installation, soak piston felt oilers in SAE 30 engine oil and lubricate "O" rings with a high-viscosity silicone oil or barium grease "O" ring lubricant.

3. Install felt oilers and "O" ring on piston.

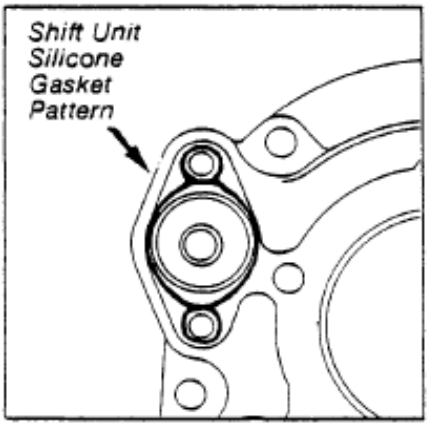
Shift Units with Piston Stop (See illustration). Before installing piston, place piston stop at base of lockout body.

4. Install compression spring over shift fork push rod. Install piston in body and secure with "O" ring, flat washer and nut. Torque nut to 20-26 ft-lbs. (27-35 N·m).

5. Install "O" ring in lockout body cover. Install cover assembly and secure with cap screws and lockwashers. Torque cap screws to 96-108 IN-LBS. (11-12 N·m).



4x4 Axle Series 185, 220. 6x6 Axle Series D346-P, 386-P, 406-P.



4x4 Axle Series 230, 260, 300, 350. 6x6 Axle Series D466-P, 486-P, 586-P, 656-P.

Shift Units for "Interlock Type" Inter-axle Differential Lockout and Steer-Drive Axle Lockup

(Dual Range Rear Axles and Steer-Drive Axles or Dual Range Rear Axles with Single Reduction Steer-Drive Axles)

Disassemble Cylinder

1. Remove cap screws, lockwashers, cover assembly and "O" ring.

2. Remove hex-nut piston and "O" rings.

3. Remove body cap screws and lockwashers, then remove body and piston as an assembly.

Assemble Cylinder

1. Apply gasket compound to mounting surface on power divider cover.

2. Install lockout body. Secure with cap screws and lockwashers. Torque cap screws to 48-56 ft-lbs. (65-76 N·m).

NOTE: Before installation, soak piston felt oilers in SAE 30 engine oil and lubricate "O" rings with a high-viscosity silicone oil or barium grease "O" ring lubricant.

3. Install felt oilers and "O" ring on piston.

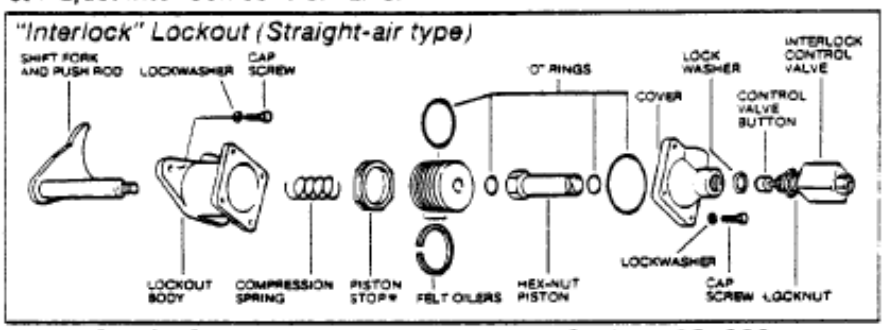
Shift Units with Piston Stop (See illustration). Before installing piston, place piston stop at base of lockout body.

4. Install compression spring over shift fork push rod. Install piston in body. Install "O" ring over push rod and in piston. Install hex-nut piston and tighten to 20-26 ft-lbs. (27-35 N·m). Install "O" ring on piston.

5. Install "O" ring in lockout body cover. Install cover assembly and secure with cap screws and lockwashers. Torque cap screws to 96-108 IN-LBS. (11-12 N·m).

6. Adjust interlock control valve.

"Interlock" Lockout (Straight-air type)



*PISTON STOP: Used only on 4x4 Axle Series 185, 220, and 6x6 Axle Series D346-P, 386-P, 406-P.

NOTE: Inter-axle differential lockout shift units are only used on 6x6 drive systems.

Interlock Control Valve

Repair and Replacement. Replace faulty valve as an assembly.

Remove Valve

1. Loosen locknut and unscrew valve body from cylinder body.

Install and Adjust Valve.

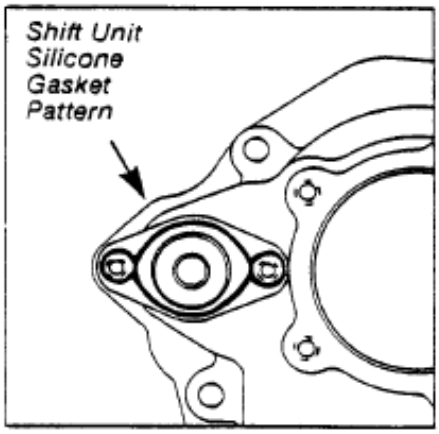
NOTE: If button is not assembled to valve stem, install as follows: Insert valve stem to full depth of the button. Lock in place with set screw. Torque set screw to 6 IN-LBS. (0.7 N·m).

1. With button assembled to valve, install locknut and lockwasher on valve body. With lockout cylinder exhausted, screw the valve assembly into the lockout cylinder cover until the valve is seated on hex-nut piston.

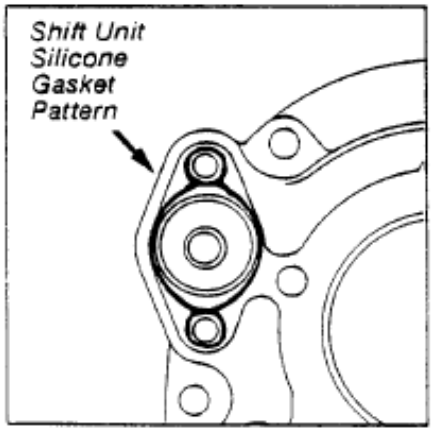
2. To adjust, unscrew control valve until the valve air-delivery port is aligned with the lockout cylinder air-inlet port.

NOTE: Do not unscrew valve more than 360°.

Lock the valve in place with locknut. Torque locknut to 35 IN-LBS. (3.9 N·m).



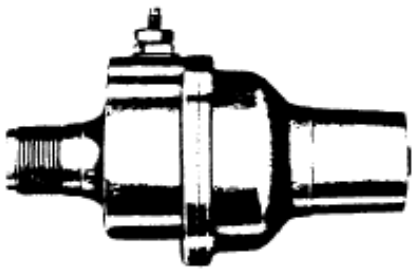
4x4 Axle Series 185, 220. 6x6 Axle Series D346-P, 386-P, 406-P.



4x4 Axle Series 230, 260, 300, 350. 6x6 Axle Series D466-P, 486-P, 586-P, 656-P.

Special Components for Shift Systems with Dual Range Axles

Speedometer Adapter



The speedometer adapters are lubricated and sealed for life of the unit. No maintenance is required. Replace a faulty unit.

Solenoid Valve

Replace solenoid valve as an assembly. The valve should not be serviced.

Quick Release Valve

If quick release valve fails to operate properly, it may be repaired as follows: Disassemble valve. Inspect valve body, valve seat and spring (if used) for evidence of faulty operation. Replace faulty parts, then reassemble valve.

Pressure Switch

Replace pressure switch as an assembly.

Lockout Control Valve

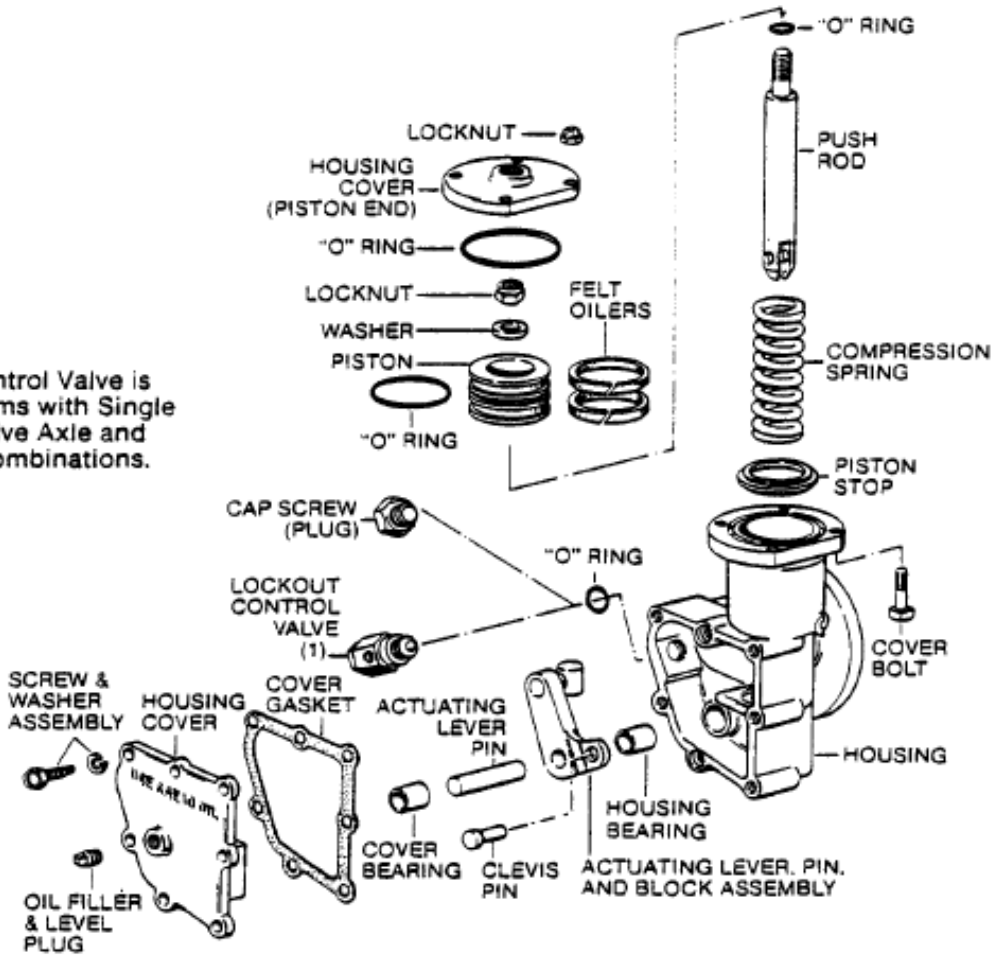
(For 4x4 System with Dual Range Rear Axle and Single Reduction Steer-Drive Axle, and 6x6 System with Dual Range Tandem, Single Reduction Steer-Drive Axle)

If lockout control valve fails to operate properly, unscrew cap nut and remove internal parts. Inspect plunger and valve parts for evidence of faulty operation. Replace faulty valve assembly.

Lockout Control Valve

Air Shift Unit *(For Dual Range Axles and Controlled Traction Differentials)*

(1)
NOTE: Lockout Control Valve is used on Shift Systems with Single Reduction Steer-Drive Axle and Dual Range Axle Combinations.



Typical Air Shift Unit

Description and Operation

These Piston Air Shift Units are mounted on the axle differential carriers and are used to shift axles for range selection and for disengagement and engagement of Controlled Traction Differentials.

Basically, all shift units operate the same and contain similar components. Mounting configuration may change with axle applications.

The shift units are mechanically connected to the axle shift forks and clutches.

The unit consists of an air chamber, piston, compression spring and mechanical linkage. When air is admitted to the chamber or cylinder, the piston travels downward against a compression spring, transferring motion through a push rod and actuating lever to the shift fork, shifting the axle into High Range (or engaging controlled traction differential). Exhaust of air pressure permits the heavy-duty spring to return the axle gearing to Low Range (or disengage controlled traction differential).

Air Shift Unit Replacement

Remove Unit

Disconnect air line at shift unit cover. Remove nuts, flat washers and piston air-shift unit from differential carrier.

NOTE: When shift unit is removed, provide container to catch oil that escapes from reservoir. Remove shift fork seal and spring.

Install Unit

1. Lubricate shift fork. Slide seal and spring assembly over fork and seal on differential carrier studs. Shift axle into Low Range.

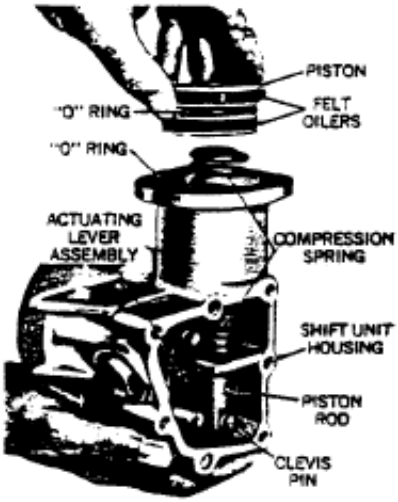
2. Place shift unit on mounting studs and make certain shift fork actuating lever engages slot in shift fork. Install flat washers and stud nuts. Tighten nuts to 55-61 ft-lbs. (74-82 N·m).

3. When axle is installed in vehicle, fill shift unit housing to level of filler plug with SAE 10 oil or automatic transmission fluid (see Lubrication on following page). Coat threads of filler plug with sealer and install plug.

4. Connect air lines to shift unit cover.

Air Shift Unit Overhaul

Disassemble Unit

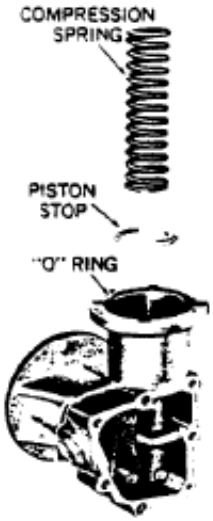


1. Remove cap screws, lock washers, cover and gasket from housing. Drain lubricant.

2. Remove bolts, locknuts, cover at piston end of housing. Remove "O" ring.

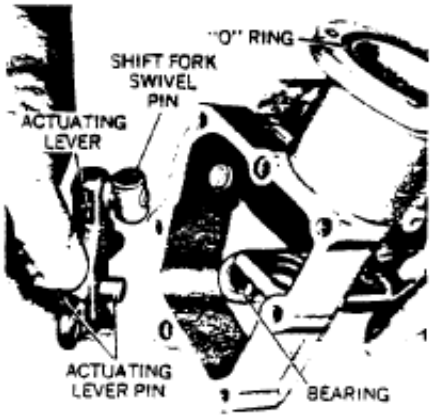
⚠ **CAUTION:** DURING THE FOLLOWING PROCEDURE, THE PISTON WILL POP OUT OF HOUSING UNDER SPRING PRESSURE. EXERCISE CAUTION TO PREVENT POSSIBLE INJURY.

3. Remove locknut, flat washer, and piston from push rod. Remove "O" ring and felt oilers from piston.



4. Remove compression spring and piston stop from bore of shift unit housing.

5. Remove clevis pin, then remove push rod from shift unit housing. Remove "O" Ring from push rod.



6. Remove actuating lever and pin assembly from shift unit housing. Do not disassemble actuating lever.

Parts Inspection

Shift Fork Seal—Inspect shift fork seal for defects and tight fit on shift fork. A spring is used to assure a closer fit of seal around shift fork. If this spring is not present on axle being serviced, install one when reassembling unit.

"O" Rings, Felt Oilers and Gasket—Replace "O" rings, felt oilers and cover gasket when piston air-shift unit is disassembled for repair.

Compression Spring—Inspect spring for distortion, cracks, or other visual defects. Replace a faulty spring.

Actuating Lever and Pins—Inspect lever pins and bearings for worn or grooved condition. Inspect actuating lever and push rod for worn or elongated holes at point where they are connected. Replace faulty parts.

Piston—Inspect piston friction surface for worn, grooved or damaged condition which will affect the piston movement in cylinder. Replace a faulty piston.

Air Shift Unit Overhaul (Cont'd)

Assemble Unit

NOTE: Prior to assembly, the piston felt oilers should be soaked in SAE 10 oil for one hour. Lubricate "O" rings with a high-viscosity silicone oil or barium grease "O" ring lubricant.

1. Assemble pin to actuating lever and install this assembly in shift unit housing.

2. Assemble "O" ring and piston to push rod and fasten with flat washer and locknut. Tighten nut to a torque of 120-150 IN-LBS. (14-17 N·m). Install felt oilers and "O" ring in piston.

CAUTION: DURING THE FOLLOWING PROCEDURE USING A PRESS, MAKE CERTAIN COMPONENTS ARE PROPERLY ALIGNED IN PRESS TO PREVENT POSSIBLE PERSONAL INJURY OR DAMAGE TO PARTS.

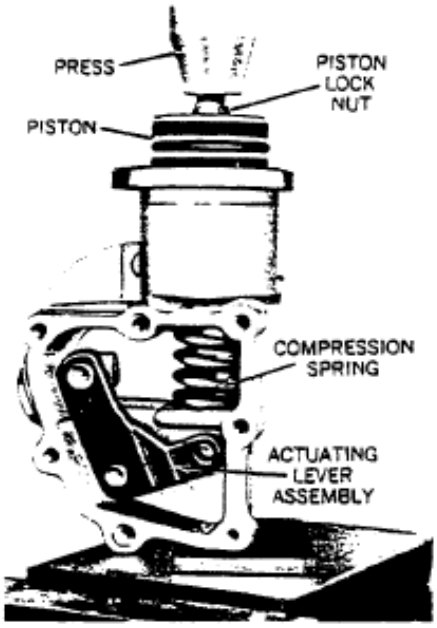
3. Insert piston stop and compression spring in shift unit housing. Place piston and push rod assembly in housing. Position housing assembly in arbor press.

4. Apply pressure to piston until actuating lever is in alignment with push rod end. Install clevis pin. Release press.

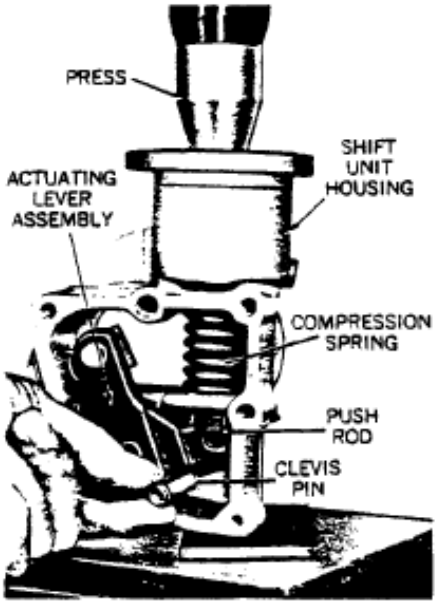
5. Place cover gasket in position on shift unit housing then install cover and bearing assembly and fasten with cap screw and lockwashers. If necessary, use a sealer on threads of cap screws to prevent any leaking. Tighten screws to a torque of 90-110 IN-LBS. (10-12 N·m).

6. Place "O" ring in groove of shift unit housing, then install housing cover and secure with bolts and locknuts. Tighten locknuts evenly to a torque of 108-132 IN-LBS. (12-15 N·m).

7. Fill shift unit with SAE 10 oil or automatic transmission fluid (see Lubrication) when axle is installed in vehicle.



Shift Unit Housing in Press.



Installing Push Rod Clevis Pin.

Lubrication

Lubricant—Use SAE 10 motor oil* for temperature above 0° F (-18° C). For temperatures below 0° F (-18° C), mix three parts of SAE 10 motor oil with one part of kerosene. This cold weather mixture can be safely used up to 32° F (0° C).

***NOTE:** Commercially available automatic transmission fluid may be used in place of SAE 10 motor oil. Automatic transmission fluid can be used for all temperatures. Do not mix kerosene with automatic transmission fluid.

Lubricant Check and Level—Each 20,000 miles or six months, remove pipe plug in shift unit housing cover to check lubricant level. Lube should be level with bottom of filler hole.

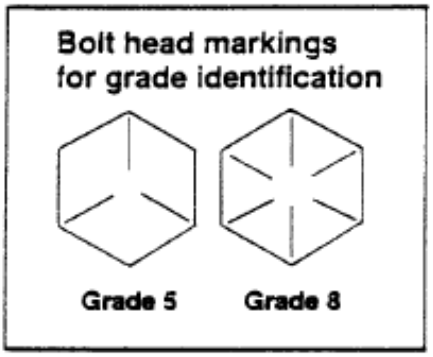
Lubricant Change—At least once a year remove shift unit housing cover and drain old lubricant. Wash parts thoroughly and air dry. Reinstall cover. Remove pipe plug in cover. Fill through pipe plug opening until lube is level with bottom of filler hole.

These instructions include fastener tightening torque values for the steer-drive and tandem axles for 4x4 Drive Systems. Contents are listed below.

Correct tightening torque values are extremely important to assure long Spicer Axle life and dependable performance. Under-tightening of attaching parts is just as harmful as over-tightening. Exact compliance with recommended torque values will assure the best results.

The data includes fastener size, grade and torque tightening values. Axle models are included to pinpoint identification of fasteners for your particular axle.

To determine bolt or cap screw grade, check for designation stamped on bolt head (see illustration).



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STEER-DRIVE AXLE (ESD-18)

Steering and Wheel End Equipment 2

Differential Carriers (all gearings) 3

4x4 REAR AXLES

Power Divider (all models) 4

DIFFERENTIAL CARRIERS

Axle Series 185, 220
(Single Reduction, Dual Range
and Double Reduction) 5

Axle Series 230, 260, 300, 350
(Single Reduction, Dual Range
and Double Reduction) 6

Steering and Wheel End Equipment
Model ESD-18

Fastener Tightening Specifications

Fastener	Size	Grade	Ft-lbs.	N-m
HUB CAP				
Nut			170-220	231-298
WHEEL BEARING ADJUSTING NUT				
Cap Screw	3/8-24	(5)	40	55
KINGPIN				
Nut	1-1/2-18		500	680
KINGPIN COVER				
Cap Screw	5/8-11	(8)	170-220	231-298
Nut	3/4-16		280-360	380-488
STEERING ARM BALL STUD				
Nut	7/8-14		450	613
AXLE BALL SEAL RETAINER				
Cap Screw	3/8-16	(5)	30	40
AXLE BALL TO HOUSING				
Cap Screw	5/8-11	(8)	170-220	231-298
Stud/Nut	3/4-16	(8 stud)	280-360	380-488
AXLE SHAFT CAGE RING				
Cap Screw	1/2-20	(8)	95	130
TIE ROD END				
Ball Stud/Nut	7/8-14		450	613
Clamp Bolt/Nut	5/8-11		60-80	81-110
AIR CHAMBER MOUNTING				
Nut	5/8-18	(5)	130-180	176-244
CHAMBER BRACKET TO SOCKET				
Cap Screw	1/2-13	(8)	80-110	110-149
SPINDLE TO BALL SOCKET				
Cap Screw			220	350
BRAKE SPIDER & SPINDLE TO AXLE BALL SOCKET (12 pt)	5/8-11	(8)	170-220	231-298

Single Reduction, Dual Range, Double Reduction

(Specifications are the same for all models unless specified otherwise)

Fastener Tightening Specifications

Fastener	Size	Grade	Ft-lbs.	N-m
RING GEAR	**Single Reduction**			
Bolt/Nut	5/8-18	(8)	180-220	244-298
	Dual Range & Double Reduction			
	9/16-18	(5)	150-170	203-230
DRIVE PINION				
Nut	1-1/2-18		560-700	759-949
PINION BEARING CAGE				
Cap Screw	9/16-12	(5)	100-125	136-170
DIFFERENTIAL CASE	**Single Reduction**			
Cap Screw	9/16-12	(8)	150-180	203-244
	Dual Range & Double Reduction			
	1/2-13	(8)	90-110	122-149
DIFFERENTIAL BEARING CAP	**Single Reduction**			
Cap Screw	3/4-10	(8)	360-440	488-596
	Dual Range & Double Reduction			
	13/16-10	(8)	370-430	501-583
DIFFERENTIAL BEARING ADJUSTER LOCK				
	Dual Range & Double Reduction			
Cap Screw	5/8-11	(5)	160-176	217-239
DIFFERENTIAL CARRIER				
Stud/Nut	5/8-18	(8 stud)	220-240	298-325
SHIFT UNIT MOUNTING				
Stud/Nut	7/16-20	(8 stud)	55-61	74-82
SHIFT FORK COVER				
Cap Screw	7/16-14	(5)	35-45	47-61

(Specifications are the same for all Axle Series unless specified otherwise)

Fastener Tightening Specifications

Fastener	Size	Grade	Ft-lbs.	N-m
INPUT SHAFT	**185, 220**			
Nut	1-5/8-18		780-960	1059-1301
	230, 260, 300, 350			
	1-7/8-12		840-1020	1139-1383
INPUT SHAFT BEARING COVER				
Cap Screw	1/2-13	(5)	75-85	101-115
FRONT OUTPUT SHAFT				
Nut	1-1/2-18		560-700	759-949
FRONT OUTPUT SHAFT BEARING COVER				
Cap Screw	7/16-14	(5)	48-56	65-76
	9/16-12	(5)	110-125	149-170
	1-3/4-12		840-1020	1139-1383
DRIVE PINION	**D346-P, 386-P, 406-P**			
Nut	1-1/2-18		840*	1139*
	D466-P, 486-P, 586-P, 656-P			
Nut	1-3/4-12		980*	1329*
	***IMPORTANT:** Torque nut to rated value, then continue tightening nut to align slot with nearest hole in pinion shank.			
DRIVE PINION BEARING CAGE				
Cap Screw	9/16-12	(8)	155-175	210-237
POWER DIVIDER COVER				
Cap Screw	9/16-12	(5)	110-125	149-170
LOCKUP SHIFT UNIT BODY				
Cap Screw	7/16-14	(5)	48-56	65-76
SHIFT UNIT BODY COVER				
Cap Screw	1/4-20	(5)	96-108 IN-LBS.	11-12
SHIFT UNIT PUSH ROD				
Nut	3/8-24		20-26	27-35

Fastener Tightening Specifications

Axle Series 185, 220 (All Models) Single Reduction, Dual Range, Double Reduction

(Specifications are the same unless specified otherwise)

Fastener	Size	Grade	Ft-lbs.	N·m
RING GEAR	**Single Reduction**			
Bolt/Nut	5/8-18	(8)	180-220	244-298
	Dual Range & Double Reduction			
	9/16-18	(8)	110-130	149-176
DRIVE PINION				
Nut (slotted w/roll pin)	1-1/2-18		840*	1139*
	***IMPORTANT:** Torque nut to rated value, then continue tightening nut to align slot with nearest hole in pinion shank.			
DRIVE PINION BEARING CAGE				
Cap Screw	9/16-12	(8)	155-175	210-237
DIFFERENTIAL CASE	**Single Reduction**			
Cap Screw	9/16-12	(8)	116-130	157-176
	Dual Range & Double Reduction			
	1/2-13	(8)	90-110	122-149
DIFFERENTIAL BEARING CAP	**Single Reduction**			
Cap Screw	3/4-10	(8)	360-440	488-596
	Dual Range & Double Reduction			
	13/16-10	(8)	370-430	501-583
DIFFERENTIAL BEARING ADJUSTER LOCK				
	Dual Range & Double Reduction			
Cap Screw	5/8-11	(5)	160-176	217-239
DIFFERENTIAL CARRIER				
Stud/Nut	5/8-18	(8 stud)	220-240	298-325
AXLE HOUSING COVERS				
Stud/Nut	7/16-20	(8 stud)	70-86	94-116
Cap Screw	7/16-14	(5)	48-56	65-75
SHIFT UNIT	**Dual Range**			
Stud/Nut	7/16-20	(8 stud)	55-61	74-82
SHIFT FORK COVER	**Double Reduction**			
Cap Screw	7/16-14	(5)	35-45	47-61

Fastener Tightening Specifications

Axle Series 230, 260, 300, 350 (All Models) Single Reduction, Dual Range, Double Reduction

(Specifications are the same unless specified otherwise)

Fastener	Size	Grade	Ft-lbs.	N-m
RING GEAR	**Single Reduction**			
Bolt/Nut	5/8-18	(8)	180-220	244-298
	Dual Range & Double Reduction			
	9/16-18	(8)	110-130	149-176
DRIVE PINION				
Nut (slotted w/roll pin)	1-3/4-12		980*	1329*
	***IMPORTANT:** Torque nut to rated value, then continue tightening nut to align slot with nearest hole in pinion shank.			
DRIVE PINION BEARING CAGE				
Cap Screw	9/16-12	(8)	155-175	210-237
DIFFERENTIAL CASE	**Single Reduction**			
Cap Screw	5/8-11	(8)	165-195	224-264
	Dual Range & Double Reduction			
	9/16-12	(8)	116-130	157-176
DIFFERENTIAL BEARING CAP				
Cap Screw	13/16-10	(8)	370-430	501-583
DIFFERENTIAL BEARING ADJUSTER LOCK				
	Dual Range & Double Reduction			
Cap Screw	5/8-11	(5)	160-176	217-239
DIFFERENTIAL CARRIER				
Stud/Nut	5/8-18	(8 stud)	220-240	298-325
		(At Dowels)	150-170	203-230
Cap Screw (12 pt)	5/8-11	(8)	210-230	285-312
AXLE HOUSING COVERS	**230, 260 Axle Series**			
Stud/Nut	7/16-20	(8 stud)	70-86	94-116
Cap Screw	7/16-14	(5)	47-55	64-75
	300, 350 Axle Series			
Stud/Nut	1/2-20	(8 stud)	110-130	149-176
Cap Screw	1/2-13	(5)	78-85	101-115
SHIFT UNIT	**Dual Range**			
Stud/Nut	**7/16-20**	(8 stud)	55-61	74-82
SHIFT FORK COVER	**Double Reduction**			
Cap Screw	7/16-14	(5)	35-45	47-61

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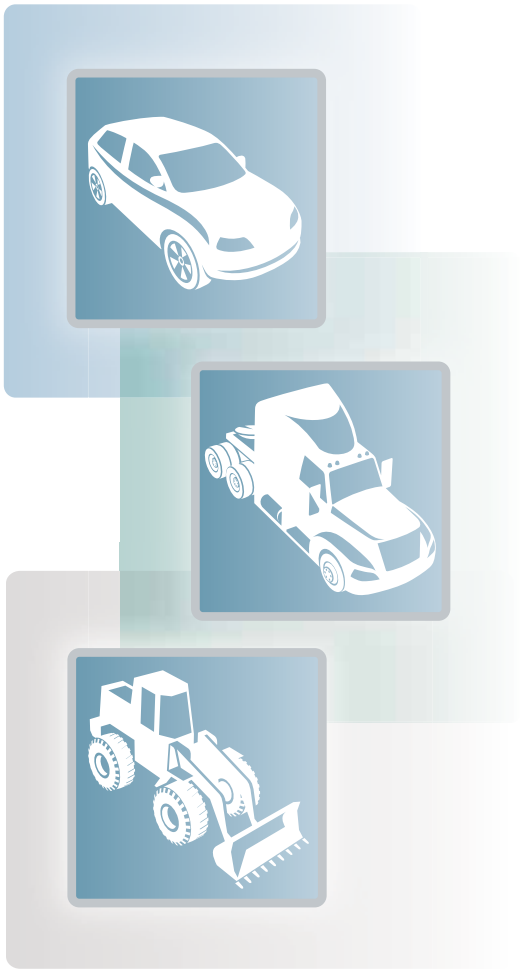

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